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# NEW NUCLEAR DATA

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Washington 25, D. C.

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Table 1. Radioactivity, Levels, Abundances, Moments

## INTRODUCTION

This issue of Nuclear Science Abstracts, Volume 11, No. 6B, contains the first quarterly cumulation of new nuclear data for 1947. The coverage in this cumulation begins where it left off for the 1956 annual cumulation, Nuclear Science Abstracts, Volume 10, No. 24B.

The 1952, 1953, 1954, 1955, and 1956 annual cumulations are contained in issues 24B of Vols. 6, 7, 8, 9, and 10 respectively. The supply of extra copies for 1952, 1953, and 1954 is exhausted; for 1955 and 1956 copies are obtainable for $0.60 from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Remittance should be by check or money order. Add 25% for foreign postage.

The tables of new data on Neutron Cross Sec-

tions, Ground State Q's, Mass Differences, and Nuclear Spins and Moments have been omitted from this issue but will be included in the semi-annual cumulation issue 12B.

Nuclear Data Cards: As the current literature is surveyed, the new nuclear results are first printed on 3-by-5-inch cards which are collected into sets of about 150 cards each month. Individuals, laboratories, or libraries may subscribe to the card sets directly by applying to the Publications Office, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D. C.

Due to the response to this service it has been possible to reduce the subscription charges to the following: U. S. and Canada $15 (1st class postage), formerly $20; elsewhere $15 (printed matter postage) or $19 (1st class postage), formerly $30 airmail). Airmail rates: $30 for Europe, $45 for Asia or Australia.

Nuclear Level Schemes: The first section of a new comprehensive nuclear data table prepared by the Nuclear Data Group was published late in 1955 by the Government Printing Office. The aim of Nuclear Level Schemes is to provide a revision and expansion of Nuclear Data which was issued in 1950 as Circular 499 of the U. S. National Bureau of Standards. It will be published in five or six sections, each one of which will be issued upon completion. The first section, now available gives the data for known nuclei with mass numbers between A = 40 and A = 92, thus covering roughly the elements $_{20}$Ca through $_{40}$Zr. The second section will summarize the information for the next 20 elements, the third for 20 more, and so on.

The style of presenting data in Nuclear Level Schemes is very similar to that used on the Nuclear Data Cards and in the cumulated lists of Nuclear Science Abstracts. The cards, or the lists, will thus provide a convenient means of keeping this table up to date.

Nuclear Level Schemes (A = 40 to A = 92), TID-5300, can be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.75, 240 pages paperbound. Remittance should be by check or money order. Add 25% for foreign postage.

# CONVENTIONS

All energies are given in Mev and all cross sections in barns unless otherwise stated in the tabular material.

Numerals in italics, following measured values, are the errors (as reported by the authors) in the last figure of the values. In cases where confusion seems possible, the conventional ± is used.

Magnetic moments are reported as before without diamagnetic correction. They are based on $\mu(H) = 2.79267$ and the substandards listed by H. Walchli, ORNL-1469.

In writing reactions, the upper right hand superscript denoting A, the mass number of the target nucleus, is given without parentheses when the target was monoisotopic or when enriched (or depleted) material was used to establish the identity of the reacting isotope. It is given in parentheses when natural material was used and when the identity of the reacting isotope was strongly suggested by its predominating abundance, the observed reaction energy, or the activity or yield of the end product. It is given in parentheses with a question mark when the target A was assigned by systematics, elimination, etc. For instance, "$B^{10}$(d,p)" means that the proton groups from the deuteron bombardment of $B^{10}$ were identified by comparing effects in $B^{10}$ enriched and natural B samples. "$B^{11}$(d,p)" means that the assignment to $B^{11}$ was made by using $B^{11}$ depleted and natural B samples. "$C^{(12)}$(d,p)" means that natural C was used to study the reaction, but, because of the 99% abundance of $C^{12}$, the reaction observed was assumed to take place in that isotope. In the reaction "$Sn^{(116)}$(n,p)$13^{s}In$," the Sn isotope was identified by the In product. "$Te^{(125?)}$(d,p)$Te^{(126?)}$" indicates that from the trend of Q values in the region, the experimenters believed that their measured Q most likely belonged to the indicated reaction.

When a method of production of a radioactive nucleus is given, the lowest bombarding energy used by the experimenter is indicated; e.g., Ag(20-Mev p,n).

The large black dots on the decay schemes are used to indicate experimentally established coincidences. $\alpha$, $\beta$, or $\gamma$ rays entering a level and dotted at their arrowheads have been shown to be in coincidence with gamma rays leaving the same level and dotted at their origins. In case of a simple cascade, the dots of the incoming and outgoing rays are superimposed. Dashes are used for doubtful radiations or levels.

For the light nuclei, energy levels in the compound nucleus are usually tabulated rather than the resonant energy of the bombarding particle. The binding energy of the bombarding particle in the compound nucleus is taken from the table of F. Ajzenberg, T. Lauritsen, Revs. Modern Phys. 27, 77(1955) for $Z < 11$ and from P. M. Endt, J. C. Kluyver, Revs. Modern Phys. 26, 95(1954) for Z from 11 to 20.

# ABBREVIATIONS

| | |
|---|---|
| a | absorption |
| a $\beta\gamma$ | absorption of $\beta$'s in coincidence with $\gamma$'s |
| a ce | absorption of conversion electrons |
| a coin | absorption of photoelectrons between counters in coincidence |
| act | neutron detection by activation (Mn, Rh, Ag, ...) |
| $\alpha$ | total $\gamma$-ray conversion coefficient, $N_e/N_\gamma$ |
| $\alpha_K, \alpha_L, \ldots$ | $\gamma$-ray conversion coefficient for electrons ejected from the K, L, ... shell |
| $\alpha_0, \alpha_1, \ldots$ | $\alpha$ to g.s., first excited state, ... of residual nucleus |
| B | band spectra method |
| B(E2) | reduced E2 excitation probability in barns$^2$ (upward transition) |
| Be($\gamma$,n) | measurement by detection of photoneutrons from Be |
| $BF_3$ | boron trifluoride neutron counter |
| $B_n, B_p$ | neutron, proton binding energy, i.e., energy necessary to remove particle from nucleus |
| $\beta\gamma$ (t_) | polarization-direction correlation of $\beta$'s and $\gamma$'s in coincidence |
| $\beta\gamma(\theta)$ | angular correlation of $\beta$'s and $\gamma$'s in coincidence |
| calc | calculated from experimental work reported elsewhere |
| cc | cloud chamber |
| CcW | Cockcroft Walton accelerator |
| ce | conversion electrons |
| chem | chemical separation of product following reaction |
| Cp | Compton |
| crit a | critical absorption |
| cryst | crystal spectrometer |
| cyc | cyclotron |
| d | (1) deuteron, (2) descendant of, (3) days, when used as superscript |
| D | average level spacing per spin state |
| d,p($\theta$) | angular distribution of protons with respect to deuteron beam |
| D($\gamma$,n),D($\gamma$,p) | measurement by detection of photoneutrons or photoprotons from deuterium |
| $\overline{E}$ | average energy |
| $E_o$ | resonance energy |
| $E_\beta, E_\gamma, \ldots$ | energy of $\beta$ ray, energy of $\gamma$ ray, |
| $E_{dis}$ | disintegration energy |
| EA | electrostatic analyzer |
| E1,E2, ... | electric dipole, electric quadrupole, ... |
| $E_\epsilon$ | energy of the electron capture transition (end point of $\gamma$ continuum + K binding energy) |
| $e_A$ | Auger electron |
| $e_{AK}$, $e_{AL}$ | KXY, LXY Auger electron |
| el | elastic scattering |
| $\epsilon$ | electron capture |
| $\epsilon$B(E2) | partial B(E2) for radiation studied (photon, $ce_K$, or $ce_L$) |
| $\epsilon_K, \epsilon_L$ | electron capture from K, L shell |
| $\eta(\theta)$ | $[W(\theta) - W(\pi/2)]/W(\pi/2)$, a measure of asymmetry in angular distributions, where $W(\theta)$ is the count at angle $\theta$ |
| f | fission |
| F-K | Fermi-Kurie plot |
| *ft* | comparative half-life in the Fermi theory of $\beta$ decay calculated for an allowed transition. Superscript 1, 2, or 3 on *f* indicates that comparative half-life is calculated for a unique 1st, 2nd, or 3rd forbidden transition. |
| g | (1) gyromagnetic ratio (2) statistical weight factor, $\frac{1}{2}[1 \pm 1/(2J+1)]$, in g $\Gamma_n$ |
| $\Gamma$ | resonance half-width (the whole width at half-maximum) |
| $\Gamma_\gamma, \Gamma_n$ | partial resonance half-width for $\gamma$, neutron emission |
| $\Gamma_n^0$ | $\Gamma_n/\sqrt{E_0(ev)}$ |
| $\gamma^\pm$ | annihilation radiation |
| $\gamma$ continuum | continuous $\gamma$ spectrum associated with electron capture |
| $\gamma(Hg^{198})$ | $\gamma$ is emitted from nucleus in parentheses rather than from radioactive parent |
| $\gamma(\theta,T)$ | $\gamma$ intensity as function of angle and temperature |
| $\gamma\gamma$, $\beta\gamma$, $\alpha\gamma$, n$\gamma$ | $\gamma\gamma$, $\beta\gamma$, $\alpha\gamma$, or n$\gamma$ concidences. (0.123 $\gamma$)(0.246 $\gamma$, 0.325 $\gamma$) means 0.123 $\gamma$ in coincidence with 0.246 $\gamma$ and 0.325 $\gamma$ |

| | |
|---|---|
| $\gamma\gamma(\theta)$ | angular correlation of $\gamma$'s in coincidence |
| $\gamma\gamma(\perp)$ | polarization-direction correlation of $\gamma$'s in coincidence |
| GM | Geiger-Müller counter |
| g.s. | ground state |
| h | hours |
| H | magnetic field |
| I | nuclear induction method |
| IB | internal bremsstrahlung |
| ic | ionization chamber |
| IT | isomeric transition |
| J | spin in units $h/2\pi$ |
| K/L, K/LM | $\alpha_K/\alpha_L$, $\alpha_K/(\alpha_L + \alpha_M)$ |
| $L_1L_2/L_3$ | $(\alpha_{L_1} + \alpha_{L_2})/\alpha_{L_3}$ |
| $l$ | orbital angular momentum |
| Lin | linear accelerator |
| m | (1) medium intensity, (2) minutes, when used as a superscript |
| M | molecular or atomic beam resonance method |
| M1,M2, ... | magnetic dipole, magnetic quadrupole, ... |
| mb | millibarns |
| Mev | million electron volts ($10^6$ ev) |
| mev | millielectron volts ($10^{-3}$ ev) |
| Mic | microwave method |
| mir | measurement by total reflection of neutron beam from mirror surface |
| mod cyc | modulated cyclotron |
| ms | (1) milliseconds, $10^{-3}$s (2) mass spectrometer |
| m$\mu$s | millimicroseconds, $10^{-9}$s |
| $\mu$ | nuclear magnetic moment (nuclear magnetons) |
| $\mu_3$ | nuclear magnetic octopole moment (nuclear magneton barns) |
| $\mu$s | microseconds, $10^{-6}$s |
| $\mu\mu$s | micromicroseconds, $10^{-12}$s |
| n res | known resonance of a "standard" element used to identify an unknown neutron energy |
| $\nu$ | neutrino |
| osc | pile oscillator method |
| $\theta^2$ | reduced level width in units of $3h^2/8\pi^2MR$ |
| p | (1) proton, (2) predecessor of |
| para | paramagnetic resonance method |
| parentheses | parentheses are put around values which are given for identification purposes |
| pc | proportional counter |
| pe | photoelectrons |
| ppl | photoplates or emulsions |
| pr | electron-positron pair |
| p res | proton resonance. Magnetic field standardized by means of proton resonance frequency |
| primes | primes indicate inelastically scattered particles |
| q | electric quadrupole moment in units of barns |
| quad res | quadrupole resonance method |
| $q_4$ | nuclear electric 16-pole moment in units of $10^{-48}$ cm$^4$ |
| Q | reaction energy in Mev |
| R | nuclear radius in fermis ($10^{-13}$ cms) |
| s | (1) spectrometer method, (2) seconds, when used as superscript |
| s coh | coherent scattering |
| S | atomic spectra measurement |
| scin | 1-crystal scintillation counter |
| scin Cp | 2-crystal scintillation counter |
| scin pr | 3-crystal scintillation counter |
| sd | double focusing spectrometer |
| sl | lens spectrometer |
| sl ce | conversion electrons measured in lens spectrometer |
| sr | steradian |
| st | strong |
| s$\pi$ | 180° spectrometer |
| s$\pi$ pr | 180° pair spectrometer |
| $\sigma$ | cross section in barns |
| $\sigma_o$ | cross section at resonance energy, $E_o$ |
| $\sigma_a$ | absorption cross section |
| $\sigma_t$ | total cross section |
| $\Sigma$pc | proportional counter used to sum energy of transitions in cascade |
| $\Sigma$scin | scintillation counter used to sum energy of transitions in cascade |
| t | (1) triton, $H^3$, (2) total cross section when used under $\sigma$ in cross section list |
| T | (1) isotopic spin, (2) temperature |
| $\tau$ | half life in units indicated |
| $\tau_1, \tau_2$ | half life of upper, lower state |
| $\tau_{\beta\beta}, \tau_{\epsilon\epsilon}$ | half life for double $\beta$, double $\epsilon$ decay |
| th | thermal |
| thresh | threshold |
| trans | transmission |
| VdG | Van de Graaff accelerator |
| w,vw | weak, very weak |

| | |
|---|---|
| $\omega_K, \omega_L$ | K, L fluorescence yield |
| x | x radiation |
| y | years |
| $Y_\gamma, Y_p, \ldots$ | yield of $\gamma$ rays, yield of protons, ... |
| % | number per 100 disintegrations. For $\gamma$'s, total number of photons plus ce's is meant |
| † | number relative to other numbers marked †. For $\gamma$'s, number of photons only is meant |
| +, − | even, odd parity when used in connection with level properties |

Standard journal abbreviations are used.

# 1. RADIOACTIVITY, LEVELS, ABUNDANCES, MOMENTS

?

Tracks (range >100$\mu$, not electrons) observed in ppl exposed to $Pb^{210}$($\beta^-$ emitter). Similar tracks found with Po, Th, Ac, Ra, Pu, and U

56A47 M.Ader, M.P.Cabannes, J. phys. radium 17, 1023 (1956).

$n^1_{0\ 1}$

$\mu$ $-1.913148$ *66* M

$\nu_n/\nu_p = 0.685057$ *17*

56C57 V.W.Cohen, N.R.Corngold, N.F.Ramsey, Phys. Rev. 104, 283 (1956); Bull. Am. Phys. Soc. 1, No. 1, 11 B7 (1956)

$H^1_{1\ 0}$

$\mu$ $+2.79273$ *4* nuclear magnetons

$+0.00152997$ *16* Bohr magnetons

Values given without diamagnetic correction

electron-cyclotron method

56F30 P.Franken, S.Liebes,Jr., Phys. Rev. 104, 1197 (1956).

$He^4_{2\ 2}$

(1) $H^2$(d,n) $E_d$ = 4.75 to 7.33

(2) $H^2$(d,np) pulsed n's 0°

$\sigma_2(\theta)$ increases with $E_d$ from 0.24 to 32 mb/sr

$\sigma_2/\sigma_1 = 0.17$ at 0°, $E_d = 6.3$, $E_n > 0.95$

d,n($\theta$, $E_d$ = 6.3) shows strong forward peaking in both reactions

56C68 L.Cranberg, A.H.Armstrong, R.L.Henkel, Phys. Rev. 104, 1639 (1956).

$He^5_{2\ 3}$

Level $Li^6$(t,$\alpha$) $E_t$ = 0.235; 89° to 97°

g.s. Q = 15.15 4 $\Gamma$ = 0.7 2

56C47 D.S.Craig, W.G.Cross, R.G.Jarvis, Phys. Rev. 103, 1427 (1956).

Level? $H^3$(d,n) $E_d$ = 1.0 to 5.0

~22 p-recoil counter 6° to 155°

Present $\sigma_t$'s combined with result of others for $E_d$ = 10.5 suggest max in $\sigma_t$ at $E_d$ ~ 8

d,n($\theta$) forward peak increases in size with $E_d$

56G51 A.Galonsky, C.H.Johnson, Phys. Rev. 104, 421 (1956); 100. 1252A (1955).

$Li^5_{3\ 2}$

$He^4$(p,p) $E_p$ = 7.5, 9.48 ppl

p,p($\theta$) found for 10° < $\theta$ < 172°

Phase shifts given

56P41 T.M.Putnam, J.E.Brolley, L.Rosen, Phys. Rev. 104, 1303 (1956); Bull. Am. Phys. Soc. 1, No. 1, 9AB2 (1956).

$Li^6_{3\ 3}$

Level $Li^6(\alpha,\alpha')$ $E_\alpha$ = 31.5; 30° to 60°

(3.58) scins dE/dx, E

$\alpha$'s to this level <4% of $\alpha$'s to either 2.19 or 4.52 level

56W29 H.J.Watters, Phys. Rev. 103, 1763 (1956).

Level $Be^9$(p,$\alpha\gamma$) $E_p$ = 2.56

(3.58) J = 0 p,$\gamma(\theta)$ $\alpha,\gamma(\theta)$

56S93 J.Stoltzfus, J.Friichtenicht, E.B. Nelson, Bull. Am. Phys. Soc. 1, No. 7, 329 J2 (1956).

$Li^7_{3\ 4}$

Level $Be^9$(d,$\alpha$) $E_d$ = 0.5 to 1.1

(4.62) s, ppl 23° to 90°

No $\alpha$'s to a 5.55 level ( <5% of $\alpha$'s to g.s.)

56G56 R.W.Gelinas, E.S.Hanna, Phys. Rev. 104, 1681 (1956); 100, 1253A (1955).

Level $Li^6$(n,$\alpha$) $E_n$ = 0.1 to 0.6

7.68 J = 5/2$^-$ $\Gamma$ = 0.18

$\theta_n^2 = 0.26$ $\theta_\alpha^2 = 0.0085$

From reanalysis of data of Blair, Holland*

56M91 J.B.Marion, G.Weber, F.S.Mozer, Phys. Rev. 104, 1402 (1956); *BNL-325 (1955).

$Be^7_{4\ 3}$

Level $Li^6$(d,$n_1\gamma$) $E_d$ = 0.3 to 1.5

(0.430) J = 1/2$^-$ $n_1\gamma(\theta)$; d,$n_1(\theta)$

56N13 G.C.Neilson, J.B.Warren, Phys. Rev. 103, 1758 (1956).

$Be^{7}_{4\ 3}$

Levels $Li^{6}(p,\alpha)He^{3}$ $E_p = 0.6$ to 2.9

~6.4 $J = 3/2^{+*}$

7.80 $J = 5/2^{-}$ $\Gamma = 0.78$

$\theta_p^2 = 0.24$ $\theta_\alpha^2 = 0.048$

*Fits data for $p,\alpha(\theta)$ s $\alpha, He^3$ 20°, 60°

56N91 J.B.Marion, G.Weber, F.S.Mozer, Phys. Rev. 104, 1402 (1956).

$Be^{8}_{4\ 4}$

Level $He^{(4)}(\alpha,\alpha)$ $E_\alpha = 0.15$ to 0.20

g.s. $\Gamma \leq 3.5$ev

$\tau \geq 1.4 \times 10^{-16}$s (half-life)

From unobservability of resonance

56H57 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 123 (1956).

Levels $Be^{9}(p,d)$ $E_p = 7.4$; 13.5°, 23°

$Be^{9}(d,t)$ $E_d = 14.8$; 15°

g.s.

2.9

No groups found to other levels in regions 0 to 6.5, 7.1 to 15.4 (<1% of g.s. group)

56C57 J.R.Cameron, Bull. Am. Phys. Soc. 1, No. 7, 324 E3 (1956); verbal report.

Level $Be^{9}(d,t)$ $E_d = 0.5$ to 1.1

(2.9) s,ppl 23° to 90°

No t's to levels between 3.4 and 4.8 (<2% of t's to 2.9 level)

56G56 R.W.Gelinas, S.S.Hanna, Phys. Rev. 104, 1681 (1956); 100, 1253A (1955).

Levels $Li^{(7)}(d,n)$ ppl 0°, 90°

g.s.

2.8 4.2

3.4 5.0

56F33 E.P.Ferreira, P.J.Waloschek, Proc. Internat. Conf. Peaceful Uses Atomic Energy (Geneva) 2, 124 (1956).

Levels $Be^{(4)}(\alpha,\alpha)$ $E_\alpha = 3$ to 6

| Level | J | Γ | $\theta^2$ |
|---|---|---|---|
| g.s. | 0 | 4.5ev *30* | 0.15 |
| (2.9) | 2 | 2.0Mev | 0.7 |
| (11.6)* | 4* | 6.7Mev* | 0.95* |

From phase shift analyses of their own data and those of Heydenburg and Temmer on $\sigma(E,\theta)$

56R41 J.L.Russell, Jr., G.C.Phillips, C.W. Reich, Phys. Rev. 104, 135 (1956); *R.Nilson, W.Jentschke, ibid.

$Be^{8}_{4\ 4}$

Levels $Li^{6}(He^{3},p)$ $E_{He^3} = 0.8$ to 5.0

g.s. scin

2.9 0° to 150°

12.6?

No p's to any other level below 14 Mev with $\Gamma \leq 1$ (<2% of p's to 2.9 level for $E_{He^3} = 2$)

56S101 J.P.Schiffer, T.W.Bonner, R.H.Davis, F.W.Prosser, Jr., Phys. Rev. 104, 1064 (1956); Bull. Am. Phys. Soc. 1, No. 7, 324 E1 (1956).

$He^{(4)}(\alpha,\alpha)$ $E_\alpha = 12.3$ to 22.9

$\alpha,\alpha(\theta,E)$ studied pc, ppl $\theta = 11°$ to 75°

56N20 R.Nilson, R.O.Kerman, G.R.Briggs, W.Jentschke, Phys. Rev. 104, 1673 (1956).

Level $Li^{6}(d,n_1\gamma)$ $E_d = 0.3$ to 1.5

22.6 n time of flight

56N13 G.C.Neilson, J.B.Warren, Phys. Rev. 103, 1758 (1956).

$Be^{9}_{4\ 5}$

Levels $Be^{9}(p,p')$ $E_p \sim 7$; s 40°, 130°

1.664? 5 edge not peak seen

2.434 5

3.03 3 $\Gamma > 0.28$

$B^{(11)}(d,\alpha)$ $E_d = 5.0$ to 7.3

g.s. $Q = 8.015$ *10* s 60°, 90°

1.669? *10* edge not peak seen

2.424 5

3.05 3 $\Gamma = 0.25, 0.43$ in two different measurements

56B118 C.K.Bockelman, A.Lévêque, W.W. Buechner, Phys. Rev. 104, 456 (1956).

Level $Be^{9}(\gamma,n)$ $E_\gamma = 1.6$ to 2.1

$\sigma_0 \sim 0.1$ 1.70 5 $\Gamma < 0.05$

$(\gamma,n)$ threshold 1.664 4

56C56 D.R.Connors, W.C.Miller, Bull. Am. Phys. Soc. 1, No. 7, 340 P12 (1956).

$Be^{9}(\gamma,p)$ $E_\gamma \leq 25$

Very few p's with $E_p > 4$ implying that transitions to low-lying $Li^8$ levels are rare

56C59 L.Cohen, A.K.Mann, B.J.Patton, K. Reibel, W.E.Stephens, E.J.Winhold, Phys. Rev. 104, 108 (1956).

$Be^{10}_{4\ 6}$

Level $Be^{9}(n,n)$ $E_n = 0.53$ to 0.9

(7.37) $J = 2^{+},3^{+}$ $\sigma(E,\theta)$

$\Gamma \sim 0.024$

56L07 R.O.Lane, J.E.Monahan, Bull. Am. Phys. Soc. 1, No. 4, 187 K1 (1956); priv. comm.

$B^{9}_{5\ 4}$

Levels $Li^6(He^3,p)$ $E_{He^3} = 0.8$ to 5.0

| | | | |
|---|---|---|---|
| | **17.6** | $\Gamma = 0.25$ | scin |
| $\sigma$'s given | **18.6** | $\Gamma = 1.5$ | 0° to 150° |

p's to g.s. stronger than p's to $Be^8$ 2.9 level
$He^3, p_0(\theta) \sim 90°$-symmetric for $E_{He^3} \leq 2$, not for $E_{He^3} = 3$ to 5
$He^3, p_1(\theta)$ not 90°-symmetric for $E_{He^3} = 2$ to 5

56S101 J.P.Schiffer, T.W.Bonner, R.H.Davis, F.W.Prosser,Jr., Phys. Rev. 104, 1064 (1956); Bull. Am. Phys. Soc. 1, No. 7, 324 E1 (1956).

$B^{10}_{5\ 5}$

Level $Be^9(d,n\gamma)$ $E_d = 0.85$ recoil

| | | |
|---|---|---|
| **(0.72)** | $\tau = 0.59^{m\mu s}$ *14* | |

56S108 J.C.Severiens, S.S.Hanna, Phys. Rev. 104, 1612 (1956); 100, 1254A (1955).

Reaction $\gamma$'s $Be^9(d,n\gamma)$
$(2.86\,\gamma)(0.72\,\gamma)(\theta) = 1 - (0.05 \pm 0.02)\cos^2\theta$
J= 2, 1, 3 or 1, 1, 3 for 3.58, 0.72, 0 levels

56S94 S.M.Shaforth, S.S.Hanna, Phys. Rev. 104, 399 (1956).

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Capture $\gamma$'s $Be^9(p,\gamma)$ scin

| 6.88 level | | $E_p = 0.330$ | |
|---|---|---|---|
| 4.5† | **0.420** *4* | 6.2† | **2.176** *20* |
| 100† | **0.731** *8* | 12† | **4.71** |
| 76† | **1.018** *7* | 60† | **5.12** |
| 4.3† | **1.426** *21* | 24† | **6.14** |
| 15† | **1.74** | | |

p(1.74, 4.71, 5.12, 6.14 $\gamma$)($\theta$) ~isotropic
Data show J(6.88 level) = $1^-$, $2^-$, or $1^+$
Conclude $J = 1^-, T = 0$ with large $T = 1$ admixture*

56C69 A.B.Clegg, Phil. Mag. 1, 1116 (1956). *D.H.Wilkinson, A.B.Clegg, Phil. Mag. 1, 291 (1956).

Levels $Be^9(p,p)$ $E_p = 0.2$ to 3.0 sd; p,p($\theta$)

| $E_o$ | Level | J | $\theta_p^2$ | $\Gamma$(kev) | $\Gamma_p/\Gamma$ |
|---|---|---|---|---|---|
| 0.330 | **6.882** | $1^-$ | ~0.5* | | 0.18 |
| 0.980 | **7.467** | $2^+$ | 0.07 | | ~0.9 |
| 0.998 | **7.486** | $2^-$ | 0.02 | 150 | 0.65 |
| 1.084 | **7.561** | $0^+$ | | 3 | |
| 1.330 | **7.792** | $2^-$ | 0.05 | 400 | 0.65 |

p,p($\theta$) analyzed
*p,d($\theta$); p,$\alpha$($\theta$) also suggest $\theta_d^2 \sim 0.4$; $\theta_\alpha^2 \sim 0.05$

56M90 F.S.Mozer, Phys. Rev. 104, 1386 (1956).

Levels $Be^9(p,p)$ $E_p = 0.8$ to 2.6 s 4 angles

| $E_o$ | Level | J | $l_p$ | $\Gamma$(kev) | $\Gamma_p/\Gamma$ |
|---|---|---|---|---|---|
| (0.998) | **(7.483)** | $2^-$ | 0 | 90 | 0.7 |
| (1.087) | **(7.563)** | $0^+$ | 1 | small | |
| 1.1 | **7.6**? | | 1 | 200 | <<1 |
| 1.35 | **7.80** *5* | $2^-$ | 0 | 500 | 0.8 |
| (2.56) | **(8.89)** | $\geq 2^+$ | $\geq 1$ | large | |

p,p($\theta$) analyzed

56D33 G.Dearnaley, Phil. Mag. 1, 821 (1956).

$B^{10}_{5\ 5}$

Levels $Be^9(p,d_o)$ $E_p = 0.8$ to 3.0 s 15° to 135°

| $E_o$ | Level | |
|---|---|---|
| 0.93 | **7.42** | $\Gamma = 130$ *30* kev |
| 1.25 | **7.70** | |
| 1.64 | **8.06** | |
| 2.3 | **8.56** | |

Levels at 7.56, 8.89 not seen. $\sigma$ (above background) <0.013 for 8.89 level

$Be^9(p,\alpha_o)$ $E_p = 0.8$ to 3.0

| | | | |
|---|---|---|---|
| 2.56 | **8.89** | $0.08 < \Gamma_\alpha < 4.0$ kev | 90° |

Anomalies also seen at $E(B^{10}) = 7.42, 7.8$

56W37 G.Weber, L.W.Davis, J.B.Marion, Phys. Rev. 104, 1307 (1956).

$B^{11}_{5\ 6}$

Levels $B^{10}(d,p)$ $E_d = 1$ to 3; d,p($\theta$)

| | |
|---|---|
| **g.s.** | $l_n = 1$ peak appears at $E_d \sim 2$ |
| **(2.14)** | No stripping effect seen* |
| **(4.46)** | 90° symmetry at $E_d = 2.0$ |
| **(5.03)** | Stripping peak at $E_d = 2.0$ |

*If $J = 1/2^-$ rearrangement would be necessary

56M69 J.B.Marion, G.Weber, Phys. Rev. 103, 1408 (1956).

Level $B^{11}(p,p'\gamma)$ $E_p = 2.0$ to 5.3

| | | |
|---|---|---|
| **(2.14)** | J = 1/2 (3/2?) | p,$\gamma(\theta)$ |

55B122 J.K.Bair, J.D.Kington, H.B.Willard, Phys. Rev. 100, 21 (1956).

Levels $B^{(10)}(d,p)$ $E_d = 4.15$ s ~110°

| |
|---|
| **6.789** *30* |
| **7.249**?*30* |
| **8.389** *30* |
| **8.957** *30* |

Isotopic assignment due to other workers

55K35 L.M.Khromchenko, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 277 (1955), Columbia Tech. Transl. p.252.

$B^{12}_{5\ 7}$

$\tau$ $18^{ms}\ ^{+1.5}_{-1.3}$ $C^{13}$(20- to 38-Mev $\gamma$,p)

$18^{ms}$

56C72 B.C.Cook, A.S.Penfold, V.L.Telegdi, Phys. Rev. 104, 554 (1956).

$\tau$ $18.5^{ms}$ *10* $B^{(11)}$(d,p)

56N15 E.Norbeck,Jr., Bull. Am. Phys. Soc. 1, No. 7, 329 J3 (1956).

$B^{12}_{5\ 7}$

Level $C^{14}(d,\alpha)$ EA 134°

g.s. Q = +0.362 *15*

56D41 R.A.Douglas, J.W.Broer, R.Chiba, D.F. Herring, E.A.Silverstein, Phys. Rev. 104, 1059 (1956).

Levels $B^{(11)}(d,p)$ $E_d$ = 4.15

g.s. Q = 1.10 s ~110°

**0.940** *30*

**1.664** *30*

**2.362*** *30*

No 1.82 level

Isotopic assignment due to other workers

*Assignment uncertain

55K35 L.M.Khromchenko, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 277 (1955), Columbia Tech. Transl. p.252; Doklady Akad. Nauk SSSR 94, 1037 (1954).

$B^{13}_{5\ 8}$ $35^{ms}$

$\tau$ $35^{ms}$ $Li^7(Li^7,p)$

Found after subtraction of $18^{ms}B^{12}$ activity

No neutrons observed

56N15 E.Norbeck,Jr., Bull. Am. Phys. Soc. 1 No. 7, 329 J3 (1956).

$C^{11}_{6\ 5}$

Levels $B^{10}(d,n)$ $E_d$ = 1.08; ppl

g.s.

**2.02** *4* } d,n(θ) ~isotropic

**4.24** *3* $l_n = 0$

**4.73** *3* $l_n = 2$

56G54 A.Graue, Phil. Mag. 1, 1027 (1956).

$C^{12}_{6\ 6}$

Polarization $H^2(d,n)$; $C^{(12)}(n,n)$

After C scattering polarization $P_2(\theta_2) \propto \sin 2\theta$ agreeing with $C^{12}(n,n)$ phase shifts

$E_d$ = 0.600 to 0.700; scin

56M70 B.M.McCormac, M.F.Steuer, C.D.Bond, F.L.Hereford, Phys. Rev. 104, 718 (1956).

Levels $B^{10}(\alpha,d)$ EA 134°

g.s. Q = +1.341 *1*

$N^{(14)}(d,\alpha)$

**9.637** Q = +3.933 *14* EA 134°

$\Gamma$ = 0.030 *8* (c.m.) implies $l_\alpha \leq 3$

56D41 R.A.Douglas, J.W.Broer, R.Chiba, D.F. Herring, E.A.Silverstein, Phys. Rev. 104, 1059 (1956).

Level $C^{(12)}(d,d')$ $E_d$ = 19

**(7.6)** $\sigma$ = 0.047 *5* ppl

Graph of $d,d'(\theta)$ given

56C65 J.Catalá, E.Villar, A.Bonet, Anales real soc. espan. fis. y quim. 52A, 93 (1956).

$C^{12}_{6\ 6}$

Levels $B^{11}(d,p)0.03\ ^8B^{12} \xrightarrow{\beta} C^{12} \xrightarrow{\alpha} Be^8$

**7.652** *4* $E_\alpha$ = 0.185 *3* g.s.

~9 $\Gamma \sim 1$ $E_\alpha \sim 1.6$ s.

$\alpha/(B^{12}\beta)$ = 0.014 $(\sim 1.6\alpha)/(0.185\alpha) \sim 0.1$

56C60 C.W.Cook, Bull. Am. Phys. Soc. 1, No. 8, 390 M9 (1956); verbal report.

Level $C^{(12)}(e,e')$ $E_e$ = 187

**(9.61)** $J = 2^+$ $(0^+)$ $e,e'(\theta)$

$\sigma(\theta)$ shows transition is probably E2 (or E0)

56P27 J.H.Fregeau, Phys. Rev. 104, 225 (1956).

Levels $B^{(11)}(p,\gamma)$ $E_p$ = 0.168

**(16.10)** $(J = 2^+)$ 0° to 120°

**(17.22)** $J = 1^-$ scin

p,16.1$\gamma(\theta) = 1 + (0.19\ 6)\cos\theta + (0.21\ 7)\cos^2\theta$

In agreement with calculation if $J = 1^-$ is assigned to 17.22 level

56C49 D.S.Craig, W.G.Cross, R.G.Jarvis, Phys. Rev. 103, 1414 (1956).

Levels* $C^{(12)}(\gamma,p)$ $E_\gamma \leq 25$

2† **17.3** ppl 90°

6† **20.8**

9† **21.5**

12† **22.6**

*If all protons observed go to $B^{11}$ g.s.

†Approximate $\int \sigma dE$ in Mev-mb

56C59 L.Cohen, A.K.Mann, B.J.Patton, K.Reibel, W.E.Stephens, E.J.Winhold, Phys. Rev. 104, 108 (1956).

$B^{10}(d,p)$ $E_d$ = 0.9 to 3.0

$B^{10}(d,\alpha)$ scin 45°, 90°, 150°

**25.9** < ($C^{12}$ excitation) < **27.7**

Maxima observed in reaction yields

| | $d,p_0$ | $d,p_1$ | $d,p_2$ | $d,p_3$ | $d,\alpha_0$ |
|---|---|---|---|---|---|
| $E_d$ | 1.0 | 1.0 | | | 1.0 |
| | 1.5 | 1.6 | 1.4 | | 1.4? |
| | 2.0 | | | ~2 | 2.0 |
| | 2.2 | | 2.2 | | |
| | 2.4 | | | | |
| | 2.7 | 2.7 | 2.8 | | |

56M69 J.B.Marion, G.Weber, Phys. Rev. 103, 1408 (1956).

$Be^9(He^3,p_0)$ $E_{He3}$ = 2.0 to 3.8

$Be^9(He^3,p_1)$

**27.8** < ($C^{12}$ excitation) < **29.1**

No resonances observed

Angular distributions not symmetric about 90°

56W32 E.A.Wolicki, H.D.Holmgren, R.L. Johnston, E.H.Geer, Bull. Am. Phys. Soc. 1, No. 7, 325 E5 (1956).

$C^{13}$ 6 7

| Level | $B^{10}(\alpha,p)$ | $E_\alpha$ = 5.3 |
|---|---|---|
| g.s. | Q = **4.10** *3* | 15 angles |

$\alpha,p(\theta)$ has max at 120°, 180° ppl
Max at 120° accounted for by Madansky-Owen "target" stripping*

56P34 A. Papkow, Z. Naturf. 11a, 776 (1956). *Phys. Rev. 99, 1608 (1955).

| Levels | $C^{(12)}(d,p)$ | $E_d$ = 4.40 |
|---|---|---|
| **3.107** *15* | | s ~110° |
| **3.699** *15* | | |
| **3.869** *15* | | |

55K35 L.M. Khromchenko, Izvest. Akad. Nauk. Ser. Fiz. SSSR 19, 277 (1955). Columbia Tech. Transl. p. 252; Doklady Akad. Nauk SSSR 93, 451 (1953).

| Levels | $C^{(12)}(d,p)$ | EA 134° |
|---|---|---|
| **3.683** | Q = **−0.960** *2* | |
| **3.853** | Q = **−1.130** *2* | |

56D41 R. A. Douglas, J. W. Broer, R. Chiba, D. F. Herring, E. A. Silverstein, Phys. Rev. 104, 1059 (1956).

| Level | $C^{(12)}(n)$ | | | |
|---|---|---|---|---|
| $\sigma_0$ = 5.7 *2* | **6.865** *8* | $\Gamma$ = 0.008 | J = 5/2 | $\sigma_t$ |

56C54 H. O. Cohn, J. K. Bair, H. B. Willard, Bull. Am. Phys. Soc. 1, No. 7, 346 X4 (1956).

| Levels | $Be^9(\alpha,n\gamma)$ | | $E_\alpha$ = 0.4 to 1.3 |
|---|---|---|---|
| broad | **(11.02)** | $(1/2^+)$ | d-recoil-ic n, scin $\gamma$ |
| sharp | **(11.08)** | | 0° to 160° |
| | **(11.97)** | $(7/2^-)$ | |
| | **(12.5)** | $(1/2^-)$ | |

$\sigma$(for $n_0$, $n_1$, and $\gamma$ production) given as $f(E_\alpha)$
$\alpha,n_0(\theta)$, $\alpha,\gamma(\theta)$, $n\gamma(\theta)$ found for several $E_\alpha$
**Results are consistent with level energy and spin assignments above. No clear indication of stripping.**

56J28 D. B. James, G. A. Jones, D. H. Wilkinson, Phil. Mag. 1, 949 (1956).

| Level | $Be^9(\alpha,n_1\gamma)$ | $E_\alpha$ = 1.3 to 2.5 |
|---|---|---|
| **11.975** *10* | $\Gamma$ = 0.09 *1* | scin $\gamma$ |

$\sigma(90°)$ = 26 mb/sr ± factor of 2 for $E_\alpha$ = 1.92
$\alpha,\gamma(\theta)$ for 6 $E_\alpha$'s given

$Be^9(\alpha,\alpha)^*$
No resonances observed
$\sigma(90°) \leq 2.6$ mb/sr for $E_\alpha$ = 1.9

55T28 N. W. Tanner, Proc. Phys. Soc. 68A, 1195 (1955); *G. Dearnaley, ibid.

$C^{15}$ 6 9 2.3$^s$

| $\tau$ | | 2.25$^s$ *5* | $C^{14}$(≥1.3-Mev d,p) |
|---|---|---|---|
| $\beta^-$ | 80% | 4.5 *2* | scin |
| | 20% | 9.5 *3* | |
| $\gamma(N^{15})$ | 100† | 5.3 | |

No 1.9$\gamma$ (<10†) No $\gamma$ with $E_\gamma$>5.3 (<5†)
2.25$^s$ activity not produced by Li(d), N(d)
Thick $Pr^{144}$ source used for F-K plot corrections

56D37 R. A. Douglas, B. R. Gasten, A. Mukerji, Can. J. Phys. 34, 1097 (1956); Bull. Am. Phys. Soc. 1, No. 1, 21 DA13 (1956).

$C^{15}$ 6 9

| Level | $C^{14}(d,p)$ | EA 134° |
|---|---|---|
| g.s. | Q = **−1.007** *1* | |

No p groups to any levels from 0.35 to 0.50 (<5% of g.s. group). Region below 0.35 obscured by $C^{12}(d,p)$. Possible level at 0.009.

56D41 R. A. Douglas, J. W. Broer, R. Chiba, D. F. Herring, E. A. Silverstein, Phys. Rev. 104, 1059 (1956).

$N^{12}$ 7 5

| Levels | $B^{10}(He^3,n)$ | | $E_{He^3}$ = 2.54 |
|---|---|---|---|
| $\int\sigma d\omega$ = 5 2 mb | g.s. | Q = **+1.46** *6* | ppl 10 angles |
| | **1.08** | **1.9?** | |
| | **1.53** | **2.35** | |

57A25 F. Ajzenberg-Selove, M. L. Bullock, E. Almqvist, Bull. Am. Phys. Soc. 2, No. 1, 28, J4 (1957); verbal report.

$N^{13}$ 7 6

| Levels | $C^{(12)}(p,p)$ | | $E_p$ = 1.5 to 5.5 | |
|---|---|---|---|---|
| | Level | J | $\Gamma$(c.m.) | $\theta^2$ |
| | **2.37** | $1/2^+$ | 0.031 | 0.54 |
| | **3.51** | $3/2^-$ | 0.055 | 0.031 |
| | **3.56** | $5/2^+$ | 0.061 | 0.21 |
| | **6.383** | $5/2^+$ | 0.011 | 0.0031 |
| | **6.90** | $3/2^+$ | 0.115 | 0.012 |

Phase shift analysis of $\sigma(E,\theta)$ made
$C^{(12)}(p,p'+4.43\gamma)$ $E_p$ = 5.0 to 5.5
**6.90** $\sigma(90°)$ = 0.016 *4*
$p,\gamma(\theta)$ consistent with $J = 3/2^+$ for this level
Suggest this state has $2^+$ core with $s_{1/2}$ proton

56R39 C. W. Reich, G. C. Phillips, J. L. Russell, Jr., Phys. Rev. 104, 143 (1956); Bull. Am. Phys. Soc. 1, No. 2, 96 N9 (1956); *H. L. Jackson, I. Galonsky, Phys. Rev. 89, 365 (1953).

| Resonance peaks | $B^{10}(He^3,p)$ Level | $\Gamma$ | $E_{He^3}$ | 1.25 to 5.0 |
|---|---|---|---|---|
| | **23.2** | 0.5 | | scin |
| | **24.5** | 0.7 | | 0° to 150° |
| | **24.8** | 0.12 | | |
| $\sigma$'s given | **25.2** | 0.15 | | |

$p_1/p_0 \sim p_1/p_2 \sim 10$ for above $E_{He^3}$
For $E_{He^3}$ = 2.1 to 4.7 $He^3,p_1(\theta)$ and $He^3,p_2(\theta)$ are 90°-symmetric; $He^3,p_0(\theta)$ is not

56S101 J. P. Schiffer, T. W. Bonner, R. H. Davis, F. W. Prosser, Jr., Phys. Rev. 104, 1064 (1956); Bull. Am. Phys. Soc. 1, No. 7, 324 E1 (1956).

$N^{14}_{7\ 7}$ Levels $O^{(16)}(d,\alpha)$ $E_d$ = 5.5 to 7.5

| | | |
|---|---|---|
| 100† | g.s. | s77 15° to 130° |
| 7† | 2.31* | |

†Yields at $E_d$ = 7.03 averaged over angle
*Forbidden transition explained by Coulomb mixing of T = 1 with T = 0 states

56B136 C.P.Browne, Phys. Rev. 104, 1598 (1956); 100, 1253A (1955).

Levels $C^{14}(p,n)$ $E_p$ = 0.6 to 3.4

g.s. Q = −0.6264 5 long counter 0°
2.3119 12 thresh n 0°

56S106 R.M.Sanders, Phys. Rev. 104, 1434 (1956).

Level $N^{(14)}(p,p'+2.31\gamma)$ $E_p$ = 2.5 to 5

2.31 2 scin $\gamma$
J = 0 from $p,\gamma(\theta)$ at 4 $E_p$ values

56B134 J.K.Bair, H.O.Cohn, J.D.Kington, H.B. Willard, Phys. Rev. 104, 1595 (1956).

Levels $N^{(14)}(\alpha,\alpha')$ $E_\alpha$ = 31.5

| | | |
|---|---|---|
| <6† | (2.31) | scins dE/dx, E |
| 100† | (3.95) | 15° to 64° |

56W29 H.J.Watters Phys. Rev. 103, 1763 (1956)

Levels $N^{(14)}(p,p')$ $E_p$ = 9.45

| | | | |
|---|---|---|---|
| 5.69 | 3 | ppl 60° to 140° | |
| 5.83 | 3 | 6.60? | 4 |
| 5.95? | | 7.03 | 2 |
| 6.23 | 2 | 7.40 | 2 |
| 6.46 | 2 | 7.60 | 2 |

Levels at 5.10, 4.91, 3.95, 2.31 also noted but no evidence for one at 3.15

56B116 E.J.Burge, D.J.Prowse, Phil. Mag. 1, 912 (1956).

Level $C^{13}(p,\gamma)$ $E_p$ = 1.16

(6.23) J = 1,2
$(2.4\gamma)(6.23\gamma)(\theta)$ consistent with either:
J = 0,1,1 with 6.23 $\gamma$ ~ pure E2 or pure M1
J = 0,2,1 with 6.23 $\gamma$ ~ pure M1

57G30 S.Gorodetzky, A.Gallmann, M.Croissiaux, R.Armbruster, Compt. rend, 244, 62 (1957); J. phys. radium 17, 550 (1956); Physica 22, 1160A (1956).

Level $C^{13}(p,\gamma)$ $E_p$ = 1.745 to 1.750

$E_o$ = 1.7469 9.164 $\Gamma$ = 0.510 kev
$\Gamma$(corrected for Doppler broadening) < 0.40 kev
$\theta^2 < 1.5 \times 10^{-3}$ thick target; scin

56M87 J.B.Marion, F.B.Hagedorn, Phys. Rev. 104, 1028 (1956).

$N^{14}_{7\ 7}$ Levels $C^{13}(p,p)$ $E_p$ = 1.5 to 3.4

| Level | J | $\Gamma$ | p,p(θ) |
|---|---|---|---|
| 9.39 | $1^-$ | 25 3 | |
| 9.51 | $3^-$ | 32 6 | |
| 9.72 | $1^+$ | 15 3 | |
| 10.29 | | 80 36 | |
| 10.51 | | 80 10 | |

Phase shift analysis made

56Z02 D.Zipoy, Bull. Am. Phys. Soc. 1, No.7, 338 P3 (1956); verbal report.

$N^{15}_{7\ 8}$ Levels $N^{(14)}(d,p)$ EA 134°

| Level | Q | |
|---|---|---|
| 7.301 | +1.308 | 1.5 |
| 7.564 | +1.045 | 1.5 |
| 8.313 | +0.296 | 1 |
| 8.571 | +0.038 | 1 |

56D41 R.A.Douglas, J.W.Broer, R.Chiba, D.F. Herring, E.A.Silverstein, Phys. Rev. 104, 1059 (1956).

Levels $C^{14}(p,n)$ $E_p$ = 0.6 to 3.4; 0°

| J | σ(0°)† | Level | | $\Gamma_n$(kev)* | $\Gamma_p$(kev)* | $\Gamma_\alpha$(kev)* |
|---|---|---|---|---|---|---|
| 1/2 | 400 | 11.291 | 2 | <1 | >5 | 0 |
| 1/2 | 315 | 11.433 | 3 | 44 | 10 | 0 |
| 3/2 | 45 | 11.765 | 3 | 55 | 0.8 | 0 |
| 3/2 | 21 | 11.875 | 3 | 22 | 0.1 | 0.05 |
| 1/2 | 48 | 11.965 | 3 | 17 | 0.7 | 0.26 |
| 5/2 | 330 | 12.097 | 4 | 24 | 2.5 | 0.6 |
| 3/2 | 650 | 12.146 | 4 | 38 | 18 | 2.2 |
| 5/2 | 73 | 12.326 | 4 | 22.5 | 0.4 | 0.1 |
| 3/2 | | 12.493 | 4 | 28 | 0.3 | 5.5 |
| †mb/sr | | 12.920 | 4 | *Data of others used | | |

56S106 R.M.Sanders, Phys. Rev. 104, 1434 (1956).

$N^{16}_{7\ 9}$ Levels $N^{15}(d,p)$ $E_d$ = 2.75

| Level | $l_n$ | d,p(θ) |
|---|---|---|
| (0.113) | 0 | |
| (0.300) | 2 | |
| (0.391) | 0 | |

56Z03 W.Zimmerman, Jr., Phys. Rev. 104, 387 (1956).

Level $N^{15}(n)$ $E_n$ = 2.8 to 3.3

5.27 $\Gamma$ = 0.14 4
J = $2^-$ or $3^\pm$ from $\sigma_{max}$ $\sigma_{min}$ for resonance

56B109 E.Baumgartner, W.Franzen, P.Huber, L.Schellenberg, F.Seiler, Helv. Phys. Acta 29, 255 (1956).

Levels $C^{14}(d,p)2.3^sC^{15}$ $E_d$ = 1.3 to 3.0

| Level | Γ(c.m.) | scin 90° |
|---|---|---|
| 12.2 | 0.270 | |
| 12.6 | 0.190 | |
| 12.8 | 0.165 | |

56D37 R.A.Douglas, B.R.Gasten, A.Mukerji, Can. J. Phys. 34, 1097 (1956); Bull. Am. Phys. Soc. 1, No. 1, 21 DA13 (1956).

$O^{15}_{8\ 7}$

Level $N^{(14)}(p,p)$ $E_p = 0.22$ to 0.65
$N^{(14)}(p,\gamma)$ s 90°, 129°, 150°
7.605 $E_o = 0.2781$ 4 scin $\gamma$
$J = 1/2$
$\Gamma = 0.0016$ 3
$p(0.75\ 1.35\gamma)(0°) \simeq p(0.75,\ 1.35\gamma)(90°)$

56O09 J.C.Overley, R.E.Pixley, W.Whaling, Bull. Am. Phys. Soc. 1, No. 8, 387 L3 (1956); verbal report.

| Levels | $N^{(14)}(p,p)$ | $E_p$ = 1.5 to 3.5 |
|---|---|---|
| 8.79 1 | | 39° to 140° c.m. |
| 8.97 1 | | 9.67 1 |
| 9.03 1 | | 10.33 1 |
| 9.55 1 | | 10.52 1 |

56B114 C.R.Bolmgren, G.D.Freier, J.G.Likely, K.F.Famularo, Bull. Am. Phys. Soc. 1, No. 7, 339 P4 (1956); verbal report.

Levels $N^{(14)}(p,p'+2.31\gamma)$ $E_p = 2.5$ to 5 scin 0°, 90°

| Level | $\Gamma$(kev) |
|---|---|
| 11.00 1 | 90 |
| 11.08 1 | 25 |
| 11.83 2 | 80 |
| 11.91 1 | 70 |

$\sigma(90°)$ = 3.9 6 mb/sr

56B134 J.K.Bair, H.O.Cohn, J.D.Kington, H.B. Willard, Phys. Rev. 104, 1595 (1956).

Levels $C^{(12)}(He^3,p)$ $E_{He^3} = 2.0$ to 3.8

| Level | p group | $\Gamma$ | 7° to |
|---|---|---|---|
| 13.82 | $p_o$(W) | <0.1 | 150° |
| 14.08 | $p_o$(W), $p_1$ | ~0.2 | |
| 14.3 | $p_1$ | ~0.2 | |
| 14.48 | $p_o$, $p_1$ | ~0.2 | |
| 15.0 | $p_o$ | ~0.2 | |

56H65 H.D.Holmgren, E.H.Geer, R.L.Johnston, E.A.Wolicki, Bull. Am. Phys. Soc. 1, No. 7, 325 E8 (1956).

$O^{16}_{8\ 8}$

Reaction $\gamma$'s $F^{19}(p,\alpha\gamma)$ $E_p = 5.2$ to 6
$N^{15}(d,n\gamma)$ $E_d = 4.5$ scin pr
3.86 3
8.87
(3.86 $\gamma$)(7.12$\gamma$), no other (3.86$\gamma$)$\gamma$ indicating $O^{16}$ $0^-$ level at 10.98
(8.87$\gamma$)/(2.73$\gamma$) = 0.06 3
No strong $\gamma$'s with $7.5 < E_\gamma < 11.5$

57B42 R.D.Bent, T.H.Kruse, L.J.Lidofsky, K.E.Eklund, Bull. Am. Phys. Soc. 2, No. 1, 52 RA8 (1957); verbal report.

Level $F^{19}(p,\alpha\pi)$ $E_p = 2$
6.065 9 sl pr

56A43 D.E.Alburger, Rev. Sci. Instruments 27, 991 (1956).

$O^{16}_{8\ 8}$

Levels $F^{19}(p,\alpha)$ $E_p$ = 7.0, 7.3; s
g.s. Q = 8.110 10 60°, 90°, 130°
6.051 10 8.874 12
6.131 10 9.852 12 $\Gamma$
6.920 10 10.363 14 25 to
7.120 10 11.085 14 30kev
$\Gamma$ < 20kev for levels from 6.051 through 9.852
Two unassigned peaks just below 11.085 peak
No other $\alpha$ groups (<5% of 8.874-level group)

56S95 G.L.Squires, C.K.Bockelman, W.W. Buechner, Phys. Rev. 104, 413 (1956).

Level $F^{19}(p,\alpha\gamma)$
(6.14) $\tau = 6.4^{\mu\mu s}$ 28 recoil

56K36 D.Kohler, H.Hilton, Bull. Am. Phys. Soc. 1, No. 8, 390 M10 (1956).

Levels $N^{15}(d,n)$ $E_d \geq 1.1$ VdG
10.937 10 thresh n ~ 0°
11.063 15

57W19 J.Weil, K.W.Jones, L.J.Lidofsky, H. Smotrich, J.Baicker, Bull. Am. Phys. Soc. 2, No. 1, 52 RA7 (1957).

Levels $N^{15}(p,p)$ $E_p = 0.65$ to 1.80
s 90°, 129°, 150°

| Level | J | $\Gamma$ |
|---|---|---|
| 12.776*7 | $0^-$ | 0.040*4 |
| 12.930 | $2^-$ | |
| 13.074 | $1^-$ | 0.140 7 |
| 13.344 | $3^-$ | |
| 13.647 | $1^+$ | |

*From measurement of $N^{15}(p,\gamma)$ resonance

56H74 F.B.Hagedorn, Bull. Am. Phys. Soc. 1, No. 8, 387 L4 (1956); verbal report.

Levels $O^{(16)}(\gamma,p)$ $E_\gamma \leq 25$; ppl

| | | |
|---|---|---|
| | 14.7 | If all p's to $N^{15}$ g.s. |
| | ~17 | |
| 2† | 19.6 | $E_p$'s show p's to $N^{15}$ g.s. |
| 2† | 20.6 | |
| 20† | 22.4 | |

†Approximate $\int \sigma dE$ in Mev-mb
$\gamma,p(\theta)$ for $E_p$ = 6 to 12 has max at ~90°

56C59 L.Cohen, A.K.Mann, B.J.Patton, K. Reibel, W.E.Stephens, E.J.Winhold, Phys. Rev. 104, 108 (1956).

Levels $N^{15}(p,n)$ $E_p = 3.7$ to ~6

| Level | $\Gamma$(kev) | Level | $\Gamma$(kev) |
|---|---|---|---|
| 16.21 | 24 | 17.63 | 70 |
| 16.3 | ~250 | 17.84 | 105 |
| 17.12 | 44 | 17.97 | 52 |
| 17.29 | 90 | 18.05 | 40 |

Threshold = 3.776 7 $BF_3$ 0°, 90°

57J11 K.W.Jones, L.J.Lidofsky, J.Weil, Bull. Am. Phys. Soc. 2, No. 1, 52 RA9 (1957); verbal report.

$O^{16}_{8\ 8}$

Levels $O^{16}(\gamma,p)$ $E_\gamma \leq 30, \leq 35, \leq 70$

| | | |
|---|---|---|
| w | 20.7 | ppl |
| st | 21.9 | If all p's to $N^{15}$ g.s. |
| w | 24.0 | |

$\int \sigma dE$ (for $E_\gamma$ = 20 to 25) = 20 Mev-mb
$\gamma,p(\theta)$ for $E_p > 7.5$ has max at ~90°

56L30 D.L.Livesey, Can. J. Phys. 34, 1022 (1956).

Level $C^{13}(He^3,p_o)$ $E_{He^3}$ = 2.0 to 3.8
$C^{13}(He^3,\alpha_o)$ 0° to 150°

w **25.7** broad

Angular distributions not symmetric about 90°

56W32 E.A.Wolicki, H.D.Holmgren, R.L. Johnston, E.H.Geer, Bull. Am. Phys. Soc. 1, No. 7, 325 E5 (1956).

Resonance $C^{13}(He^3,p)$ $E_{He^3}$ 1.25 to 5.0
peaks **25.7** $\Gamma$ = 0.5 scin
$\sigma$'s given **26.6** $\Gamma$ = 0.4 0° to 150°

$He^3,p_o(\theta)$ not 90°-symmetric for $E_{He^3}$ = 2.2 to 4.5

56S101 J.P.Schiffer, T.W.Bonner, R.H.Davis, F.W.Prosser, Jr., Phys. Rev. 104, 1064 (1956).

$O^{17}_{8\ 9}$

Ground state HDO$^{17}$

q (−?) **0.03** *1* Mic

q of Geschwind et al.* believed too small due to incorrect interpretation of the degrees of hybridization in OCS.

57S108 M.J.Stevenson, Bull. Am. Phys. Soc. 2, No. 1, 31 JA6 (1957); verbal report.
*Geschwind et al. Phys. Rev. 83, 209A (1951)

Level $C^{14}(\alpha,n)$ $E_\alpha$ = 2.335 to 2.355
g.s. Q = −**1.820** *2* thresh n

56S106 R.M.Sanders, Phys. Rev. 104, 1434 (1956).

Levels $O^{(16)}(d,p)$ $E_d$ = 4.32

| | | | |
|---|---|---|---|
| st | **g.s.** | Q = **1.885** | s ~110° |
| st | **0.893** *15* | | |
| w | **3.005** *15* | | |
| w | 3.853 *15* | | |

55K35 L.M.Khromchenko, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 277 (1955), Columbia Tech. Transl. p.252; Doklady Akad. Nauk SSSR 93, 451 (1953).

Levels $O^{(16)}(d,p)$ EA 134°
**0.870** Q = +**1.048** *2*
**0.881***

*May be due to contaminant

56D41 R.A.Douglas, J.W.Broer, R.Chiba, D.F. Herring, E.A.Silverstein, Phys. Rev. 104, 1059 (1956).

$O^{17}_{8\ 9}$

Levels $O^{(16)}(d,p)$ $E_d$ = 7.1, 7.5

| Level | $\Gamma$(kev) | s 30°, 60°, 90° Level | $\Gamma$(kev) |
|---|---|---|---|
| 4.553 *8* | 42 | | |
| 5.083 *10* | 104 | 5.695 *6* | <8 |
| 5.215 *6* | <8 | 5.731 *6* | <8 |
| 5.378 *10* | 20 | 5.866 *6* | <8 |

57B116 C.P.Browne, Bull. Am. Phys. Soc. 2, No. 1, 52RA10 (1957); verbal report.

Levels $O^{(16)}(n,\alpha)$ n's from Li(d,n)

| | | |
|---|---|---|
| 6.89 *4* | 8.27 *3* | ic |
| 7.09? | 8.41? | |
| 7.16? | 8.52 *3* | |
| 7.28? | 8.75 *3* | |
| 7.39? | 8.90 *3* | |
| 7.57? | 9.07 *3* | |
| 7.75 *3* | 9.21? | |
| 7.93 *3* | 9.45? | |
| 8.06 *3* | 9.66? | |

Measured distribution of $E_\alpha + E_{C^{13}}$
Assumed Q = −2.201

56K41 K.Kimura, I.Kumabe, K.Miyake, H.Ogata, K.Miyasita, J. Phys. Soc. Japan 11, 1211 (1956)

Levels $C^{13}(\alpha,n)$ $E_\alpha$ = 1.0 to 2.5; scin

| J | Level | $\Gamma$(kev) | $\Gamma_\alpha$(kev) | 0° to |
|---|---|---|---|---|
| 5/2(−?) | 7.16 *1* | 3.5 *10* | 0.016 *3* | 167° |
| 5/2(−?) | 7.37 *1* | ≤2 | 0.038 *6* | |
| | 7.50 *1* | 7 *3* | | |
| | 7.67 *2* | 20 *10* | | |
| | 7.92 *3* | ~100 | | |
| | 8.04 *3* | ~80 | | |
| ≤5/2 | 8.18* *3* | 60 *15* | 10 *4* or 36 *9* | |

$\alpha,n(\theta)$ given for all except 7.92, 8.04 levels
J from $\alpha,n(\theta)$, $\Gamma_\alpha$ from $\int \sigma dE$
*$\sigma(0°)$ = 36 *10* mb/sr

56R44 M.G.Rusbridge, Proc. Phys. Soc. 69A, 830 (1956).

$O^{18}_{8\ 10}$

Levels $O^{17}(d,p)$ $E_d$ = 7.8 d,p($\theta$)

| Level | $l_n$ |
|---|---|
| **g.s.** | 2 |
| (1.98) | 0, 2 |
| (3.56) | 2 |

56B115 O.M.Bilaniuk, Bull. Am. Phys. Soc. 1, No. 7, 326 G3 (1956).

Levels $F^{19}(t,\alpha)$ $E_t$ = 1.5, 1.802
$\sigma(0°)$ = 0.072 mb/sr

| | | |
|---|---|---|
| **1.989** *24* | | sd 90° |
| **3.504** *34* | **5.311** *40* | |
| **3.929** *40* | **5.456** *40* | |
| **5.007** *40* | **6.190** *40* | |
| **5.170** *40* | **6.328** *40* | |

Region from 4.42 to 4.47 obscured by $O^{16}(t,\alpha)$

56J31 N.Jarmie, Phys. Rev. 104, 1683 (1956); Bull. Am. Phys. Soc. 1, No. 1, 28 GA4 (1956).

$O^{18}$ 8 10

Levels $C^{14}(\alpha,n)$ $E_\alpha$ = 2.3 to 3.6

| Level | Γ(kev) | scin 0° |
|---|---|---|
| 8.223 4 | 1.6 1 | |
| 8.293 3 | 10 1 | J = 1,3⁻ from |
| 8.414? 11 | 22 10 | α,n(θ) |
| 8.832 15 | 100 20 | |
| 8.966 4 | 54 3 | |

$\int \sigma d\omega = 0.30$

56S106 R.M.Sanders, Phys. Rev. 104, 1434 (1956).

$O^{20}$ 8 12

$\tau$ $< 10^m$ or $> 150^y$ $O^{18}$(40-Mev α, 2p)

Assumed $\sigma[O^{18}(\alpha,2p)] \geq 0.1\ \sigma[Mg^{26}(\alpha,2p)]$

56K37 S.Katcoff, J.Hudis, J. Inorg. Nuclear Chem. 3, 253 (1956).

$F^{18}$ 9 9 1.9h

$\epsilon_K/\beta^+ = 0.030$ 2 pc $e_A/\beta^+$ scin

No $\gamma$ ($< 0.005$ per $\beta^+$)

$C_A/C_T = 0.004$ 20 from $\epsilon_K/\beta^+$

56D38 R.W.B.Drever, A.Moljk, J.Scobie, Phil. Mag. 1, 942 (1956).

$F^{18}$ 9 9

Levels $O^{(16)}(d,d)$ $E_d$ = 4.6 to 7.2

Yield at 130° shows 8 peaks; yield at 90° 5 at $E_d$'s slightly higher than those for 130°

56B135 D.W.Berger, O.J.Loper, Phys. Rev. 104, 1603 (1956).

Levels $O^{(16)}(d,\alpha)$ $E_d$ 5.5 to 7.5

Yield curves for $\alpha_0, \alpha_1, \alpha_2$ show broad peaks

56B136 C.P.Browne, Phys. Rev. 104, 1598 (1956); 100, 1253A (1955).

$F^{19}$ 9 10

Ground state

μ +2.6117 I

56S111 A.K.Saha, B.M.Banerjee, T.P.Das, D.K. Roy, S.K.Gosh Roy, T.Ghose, Indian J. Phys. 30, 211 (1956).

Levels $F^{19}(p,p')$ $E_p$ = 7.0, 7.3 s 60°, 90°, 130°

| | |
|---|---|
| 0.111 2 | |
| 0.197 2 | 2.784 8 |
| 1.350 5 | 3.912 10 |
| 1.462 5 | 4.002 10 |
| 1.558 5 | 4.036 10 |

56S95 G.L.Squires, C.K.Bockelman, W.W. Buechner, Phys. Rev. 104, 413 (1956).

Levels $O^{18}(p,\alpha)$ $E_p$ = 0.77 to 3.54 pc 90°

| | | |
|---|---|---|
| 8.749 6 | | |
| 8.883 4 | 9.856 4 | 10.524 5 |
| 9.159 10 | 10.016 4 | 10.576 5 |
| 9.287 4 | 10.070 5 | 10.606 6 |
| 9.491 4 | 10.094 5 | 10.730 5 |
| 9.554 4 | 10.125 5 | 10.825 6 |
| 9.600 5 | 10.208 5 | 10.858 6 |
| 9.623 4 | 10.276 5 | 10.953 6 |
| 9.787 4 | 10.451 5 | 11.245 6 |

56H67 H.A.Hill, J.M.Blair, Phys. Rev. 104, 198 (1956); 100, 961A (1955).

$F^{19}$ 9 10

Levels $O^{18}(p,n)$ $E_p$ = 2.5 to 3.54 long counter 0°

| Level | Γ |
|---|---|
| 10.465 5 | 0.010 3 |
| 10.537 5 | |
| 10.581 5 | < 0.020 |
| 10.832 5 | 0.033 3 |
| 10.951 6 | 0.018 6 |
| 11.047 6 | 0.029 3 |
| 11.163 6 | 0.015 3 |
| 11.255 6 | |

56H67 H.A.Hill, J.M.Blair, Phys. Rev. 104, 198 (1956); 100, 961A (1955).

Levels $O^{18}(p,\alpha)$ $E_p$ = 2.6 to 4.3 pc 90°

| | |
|---|---|
| ~1† | 11.45 |
| ~1† | 11.53 |
| ~1† | 11.65 |

Lower levels agree with those of Hill,Blair

57S118 D.Szteinsznaider, M.Roclawski-Conjeaud, V.Naggiar, Compt. rend. 244, 445 (1957).

σ $O^{18}(p,n)$ $E_p$ = 10,40

$8 < (F^{19}$ excitation$) < 48$ stacked foils

Many peaks for thin foils, $E_p < 10$. For thick foils σ has max (0.426 4) at $E_p$ = 5.6 6

56T21 Y.S.Tsai, Bull. Am. Phys. Soc. 1, No. 7 327 G4 (1956).

$F^{21}$ 9 12

Levels $F^{19}(t,p)$ $E_t$ = 1 to 2

| | |
|---|---|
| g.s. | Q = +6.200 25 |
| 0.269 40 | |
| 1.087 40 | |
| 1.694 40 | |
| 2.036 40 | |

sd 90°

Region from 1.80 to 1.87 obscured by $C^{12}(t,p)$

56J31 N.Jarmie, Phys. Rev. 104, 1683 (1956). 99, 1043 (1955); Bull. Am. Phys. Soc. 1, No. 1, 28 GA4 (1956).

Ne 10

Relative isotopic abundances ms

No $Ne^{18}$ ($< 0.05\%$)

No $Ne^{19}$, $Ne^{23}$, $Ne^{24}$, $Ne^{25}$ ($< 0.01\%$)

56K36 L.Kerwin, D.E.McElcheran, Can. J. Phys. 34, 1497 (1956).

$Ne^{20}$ 10 10

Levels $F^{19}(p,p)$ s, 4 angles

| $E_o$ | Level | J | Γ(kev) | $\Gamma_p/\Gamma$ |
|---|---|---|---|---|
| (0.669) | (13.505) | $1^+$ | 7.5 | 0.98 |
| (0.842) | (13.670) | $0^+$ | 23 | 0.99 |
| (0.874) | (13.700) | $2^-(1^-)$ | | <<1 |
| (0.935) | (13.758) | $1^+$ | | 0.1 |
| (1.346) | (14.149) | $2^-(1^-)$ | | <<1 |
| (1.372) | (14.173) | $2^-(1^-)$ | | <<1 |
| (1.422) | (14.221) | $1^+$ | 15 | 0.85 |
| (1.940) | (14.713) | | | <<1 |

Other small anomalies at $E_p$ = 1.690, 2.030

No anomalies at $E_p$ = 0.598, 1.092, 1.324

56D33 G.Dearnaley, Phil. Mag. 1, 821 (1956); 45, 1213 (1954).

**$Ne^{20}$** 10 10

Levels $F^{19}(p,\alpha_1\pi)$ $E_p = 0.8$ to 1.4

| $E_o$ | Level | J | GM $\pi$, pc $\alpha$ |
|---|---|---|---|
| 0.843 | **13.671** | $2^+$ | $p,\alpha_1(\theta)$ |
| 1.126 | **13.940** | $2^+$ | measured for |
| 1.250 | **14.058** | $1^-$ | 14 values of $E_p$ |
| 1.356 | **14.158** | $2^+$ | |

56I04 A.Isoya, K.Goto, T.Momota, J. Phys. Soc. Japan 11, 899 (1956).

**$Ne^{21}$** 10 11

Ground state

J 3/2 M

56H70 J.C.Hubbs, G.M.Grosoff, Phys. Rev. 104, 715 (1956).

**$Ne^{22}$** 10 12

Resonance $F^{19}(t,\alpha)$ $E_t = 1.1$ to 2.1

peaks **$19.3 \leq$ Excitation $\leq 20.3$** scin

Maxima for $O^{18}$ g.s. $\alpha$'s found at $E_t = 1.4, 1.9$

Maximum for $\alpha$'s to $O^{18}$ 1.99 level found at 1.8

56J31 N.Jarmie, Phys. Rev. 104, 1683 (1956).

**$Na^{23}$** 11 12

Level $Na^{23}(p,p'\gamma)$ $E_p = 1.288$

**(0.440)** $\tau = 0.1$ to $1^{\mu\mu s}$

From Doppler shift scin 0°,150°

56K31 R.W.Krone, A.Everett, S.S.Hanna, Bull. Am. Phys. Soc. 1, No. 7, 329 J4 (1956).

Level $Na^{23}(p,p'\gamma)$ $E_p = 1.29, 1.46$

**(0.440)** $J > 1/2$

J from anisotropy of $p,\gamma(\theta)$, $5/2^+$ most plausible

56R46 W.G.Read, R.W.Krone, Phys. Rev. 104, 1018 (1956); Bull. Am. Phys. Soc. 1, No. 4, 212 SA11 (1956).

Reaction $\gamma$ $Na^{23}(p,p'\gamma)$ $E_p = 1.29, 1.46$

**(0.440)** $\alpha_K = 4.9 \times 10^{-5}$ 6

$E2/M1 \leq 0.05$ sl ce,pe

J(0.440 level) > 1/2 from anisotropy of $p,\gamma(\theta)$, $5/2^+$ most plausible

56B121 R.Berenbaum, J.H.Towle, J.H.Matthews, Proc. Phys. Soc. 69A, 858 (1956).

**$Na^{24}$** 11 13

**$15^h$ g.s.**

$\tau$ **$15.01^h$** 6 V(170-Mev p) chem

56R45 G.Rudstam, Thesis, Univ. Uppsala 1956.

$\tau$ **$14.90^h$** 5 differential ic

55T07 J.Tobailem, J. phys. radium 16, 48 (1955); Ann. phys. 10, 783 (1955).

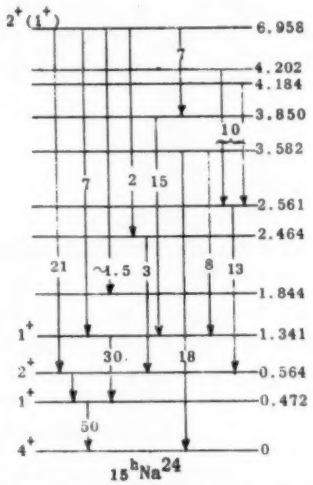
**$Na^{24}$** 11 13

Capture $\gamma$'s $Na^{23}(th\ n,\gamma)$

| | | | | | | |
|---|---|---|---|---|---|---|
| | | **~0.090** | | | | scin |
| 50 | *10*† | **0.473** | *4* | | | sl pe,Cp |
| 30 | *10*† | **0.877** | *5* | 8† | **2.210** | *15* |
| 10 | † | **1.630** | *8* | ~15† | **2.510** | *15* |
| ~3 | † | **1.900** | *20* | 7† | **3.070** | *20* |
| 13 | † | **2.030** | *10* | 18† | **3.590** | *25* |

†Photons/100 Na captures

56M92 H.T.Motz, Phys. Rev. 104, 1353 (1956); 90, 355A (1953).




Numbers in decay lines are $\gamma$'s/100 captures

4 highest energy $\gamma$'s from work of others

56M92 H.T.Motz, Phys. Rev. 104, 1353 (1956).

Resonance $Na^{23}(n)$

**0.0029** J = 1

56L41 J.E.Lynn, quoted by V.L.Sailor, Phys. Rev. 104, 736 (1956).

**Mg** 12

Levels $Mg(p,p')$ $E_p = 9.62$; s

| Isotopic Assignment | Level | Graph given for $p,p(\theta)$ |
|---|---|---|
| $Mg^{25}$ | **0.55** *5* | |
| $Mg^{25}$ | **0.98** *5* | |
| $Mg^{24}$ | **1.37** *5* | $p,p'(\theta)$* |
| $Mg^{24}$ | **4.22** *5* | $p,p'(\theta)$ |
| $Mg^{25}, Mg^{26}$ | **4.77** *5* | |
| $Mg^{24}$ | **5.24** *5* | $p,p'(\theta)$ |
| $Mg^{25}, Mg^{26}$ | **6.00** *5* | |
| $Mg^{25}$ | **6.42** *5* | |
| $Mg^{25}$ | **6.90** *5* | *also for $E_p = 8.86$ |

56G53 G.W.Greenlees, A.E.Souch, Proc. Phys. Soc. 69A, 686 (1956).

**$Mg^{24}$** 12 12

**Levels** $Na^{23}(p,p)$ $E_p = 0.4$ to 1.0

| $E_o$ | Level | $l_p$ | s 3 angles |
|---|---|---|---|
| 0.860 | **12.527** | 0 | |
| 0.92 | **12.58** | 1 or 2 | |

56T33 G.Dearnaley, Phil. Mag. 1, 821 (1956).

$Mg^{24}_{12\ 12}$ Levels $Na^{23}(p,p)$ $Na^{23}(p,\alpha)$ $Na^{23}(p,\gamma)$ $E_p = 0.58$ to 1.50 scin p 4 angles; $\alpha$ 157.5°; p, $\gamma(\theta)$

| $E_o$ | Level | $\Gamma$(kev) | $\Gamma_p/\Gamma$ | J |
|---|---|---|---|---|
| 0.594 | 12.273 | 2 *1* | 0.9 *1* | $3^-$ |
| 0.725 | 12.398 | 7 2 | >0.9 | $0^-$ |
| 0.797 | 12.467 | | 0.8 *1* | $1^-$ |
| 0.815 | 12.484 | | 0.6 2 | $2^+$ |
| 0.849 | 12.517 | | >0.6 | $4^+$ |
| 0.877 | 12.543 | 8 2 | ≥0.9 | $1^+$ |
| 0.922 | 12.587 | | 0.6 | $2^+$ |
| 0.989 | 12.651 | <1 | | 4 |
| 1.022 | 12.682 | | 0.9 | $2^-$ |
| 1.166 | 12.820 | | | $2^+$? |
| 1.176 | 12.830 | | 0.7 2 | $1^+$ |
| 1.206 | 12.859 | | | $2^-$? |
| 1.213 | 12.865 | | 0.7 2 | $3^+$? |
| 1.258 | 12.909 | | 0.5 2 | $1^+$ |
| 1.288 | 12.937 | | >0.9 | $1^-$ |
| 1.321 | 12.969 | | | $3^+$ |
| 1.365 | 13.012 | | | $0^-$? |
| 1.398 | 13.044 | | 0.7 *1* | $3^+$ |
| 1.419 | 13.064 | | | $4^+$ |
| 1.460 | 13.103 | | 0.9 *1* | $3^-$ |

Additional 16 resonances observed

56P36 F.W.Prosser, Jr., N.P.Baumann, D.K. Brice, W.G.Read, R.W.Krone, Phys. Rev. 104, 369 (1956); 104, 376 (1956).

$Mg^{25}_{12\ 13}$ Levels $Mg^{(24)}(d,p)$ $E_d = 4.04$

| g.s. | Q=+5.022 | s ~110° | |
|---|---|---|---|
| 0.503* | 2.695* | 4.857* | 6.087 |
| 0.998* | 2.871*? | 4.960 | 6.249 |
| 1.581*? | 3.924* | 5.147 | 6.542 |
| 2.022* | 4.030* | 5.341 | 6.948* |
| 2.471*? | 4.622 | 5.536* | 7.074 |

Errors are 0.040 to 0.050

*Isotopic assignment due to other workers. Other levels assigned from intensities.

55K35 L.M.Khromchenko, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 277 (1955); Columbia Tech. Transl. p.252; Doklady Akad. Nauk SSSR 93, 451 (1954).

$Al^{27}_{13\ 14}$ Levels $Al^{27}(n,n')$ $E_n = 4.4$ ppl 82°

| $\sigma$(mb/sr) | Level |
|---|---|
| 46 *10* | g.s. |
| 19 7 | (0.84) |
| | (1.01) |
| 15 5 | (2.23) |
| 15 5 | (3.0) |

No neutron group to 2.73 level ($\sigma$<3mb/sr)

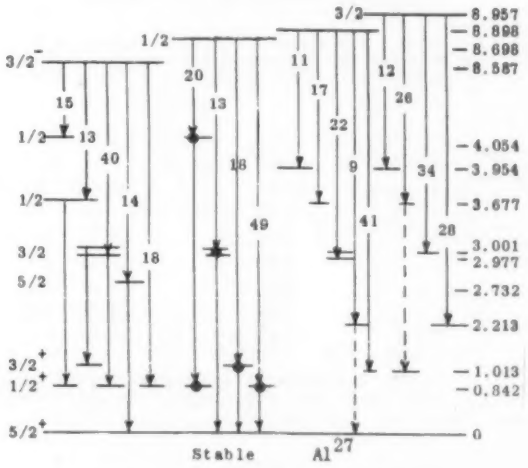
56W36 J.B.Weddell, Phys. Rev. 104, 1069 (1956).

$Al^{27}_{13\ 14}$ Levels $Mg^{26}(p,\gamma)$ $E_p \leq 0.8$ scin $\gamma$, $\gamma\gamma$ p, $\gamma(\theta)$

| Level | J | $\Gamma_p\Gamma_\gamma/(\Gamma_p+\Gamma_\gamma)$ |
|---|---|---|
| (0.842) | $1/2^+$ | 0.4 *1* ev |
| (1.013) | | |
| (2.213) | $3/2^*$ | |
| (2.732) | 5/2 | |
| (2.977) | 3/2? } | unresolved§ |
| (3.001) | 3/2? } | |
| (3.677) | 1/2 | |
| (3.954) | 1/2, 5/2* | |
| (4.054) | 1/2 | 1.4 *3* |
| (8.587) | $3/2^-$ | 0.7 2 |
| (8.698) | 1/2 | 0.21 5 |
| (8.898) | 1/2 | |
| (8.957) | 3/2 | |

*Assumed pure dipole $\gamma$ from 8.957 level

§J = 3/2 for at least one level




Numbers in decay lines are branching ratios of $\gamma$'s

56V22 C. van der Leun, P.M.Endt, J.C. Kluyver, L.E.Vrenken, Physica 22, 1223 (1956)

$Al^{28}_{13\ 15}$ Levels $Al^{27}(d,p)$ $E_d = 3.05$, 4.31

| g.s. | Q = +5.475 | | |
|---|---|---|---|
| 0.980 | 3.747? | 5.396 | |
| 1.597 | 3.934 | 5.643 | 6.641 |
| 2.152 | 4.277 | 5.784 | 6.835 |
| 2.574 | 4.469 | 5.968 | 7.013 |
| 2.929 | 4.720 | 6.148 | 7.197 |
| 3.334 | 4.883? | 6.298 | 7.599? |
| 3.520 | 5.170 | 6.438 | 7.896? |

Errors are 0.020 to 0.030

55K35 L.M.Khromchenko, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 277 (1955); Columbia Tech. Transl. p.252; Doklady Akad. Nauk SSSR 94, 1037 (1954).

Level $Al^{27}(d,p)$ $E_d = 1.2$ recoil

(0.031) $\tau = 2.1^{m\mu s}\ 3$

56S108 J.C.Severiens, S.S.Hanna, Phys. Rev. 104, 1612 (1956); 100, 1254A (1955).

$Si_{14}$ Capture $\gamma$'s $Si(th\ n,\gamma)$ sπ Cp

| | | | |
|---|---|---|---|
| 16† | 1.280* *10* | 37.4† | 4.930* *10* |
| ~3† | ~1.5* | 2.3† | 5.118* *15* |
| ~3† | ~1.7* | 0.8† | 5.242 *30* |
| 3.4† | 1.95 *2* | 1† | 6.041* *50* |
| 12.8† | 2.100* *10* | 9.2† | 6.354* *15* |
| 36.5† | 3.547* *10* | 1.4† | 6.758$ *20* |
| 3.2† | 3.667* *20* | 6.1† | 7.224* *30* |
| ~3† | ~3.8$ | 0.5† | 7.38? *3* |
| 4.2† | 3.976* *20* | 1.6† | 8.482* *15* |
| 2† | 4.30? *5* | 0.2† | 10.59$ *3* |

No 2.69$\gamma$
Study covered $E_\gamma$ = 0.25 to 11

†Photons/100 Si captures ($\sigma_a$ = 0.091)
(Max in $Si^{29}$, $Si^{30}$, $Si^{31}$ = 82†, 14†, 4†)
*Assigned to $Si^{29}$. 5.118$\gamma$ may also be in $Si^{30}$
$Assigned to $Si^{30}$
Unresolved $\gamma$'s with $E_\gamma$ < 3.5 present

56A37 B.P.Adyasevich, L.V.Groshev, A.M. Demidov, J. Nuclear Energy 3, 258 (1956); Soviet J. Atomic Energy No. 2, 40 (1956).

$Si_{14}^{28}$ Levels $Al^{27}(d,n)$ $E_d$ = 2.17

| | | |
|---|---|---|
| (1.78) | ppl 0° to 120° | |
| 4.54 *20* | | |
| 4.95 *20* | 8.31 *10* | |
| 6.24 *6* | 8.57 *8* | |
| 6.88 *6* | 9.37 *4* | |
| 7.39 *6* | 10.00 *10* | |
| 7.89 *6* | 10.25 *6* | |

56R40 A.G.Rubin, F.Ajzenberg-Selove, H.Mark, Phys. Rev. 104, 727 (1956); 100, 961A (1955).

Resonance $Al^{27}(p,\gamma)$
0.9908 $\Gamma$ = 50 *30* ev
$E_p$ changed by varying target potential (±500ev)

56B105 F.Bumiller, J.Müller, H.H.Staub, Helv. Phys. Acta 29, 234 (1956).

$Si_{14}^{29}$ Levels $Si^{(28)}(d,p)$ $E_d$ = 4.44

| | | | |
|---|---|---|---|
| g.s. | Q = +6.229 *40* | s | ~110° |
| 1.237* | | | |
| 2.038* | 4.223* | 6.453* | 7.820 |
| 2.416* | 4.931* | 6.728 | 8.354 |
| 3.083* | 5.944* | 7.000 | 8.832 |
| 3.662* | 6.138* | 7.577 | 9.112? |

Errors are 0.040 to 0.050
*Isotopic assignment due to other workers.
Other levels assigned from intensities.

55K35 L.M.Khromchenko, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 277 (1955); Columbia Tech. Transl. p.252; Doklady Akad. Nauk SSSR 98, 761 (1954).

Capture $\gamma$'s $Si^{(28)}(th\ n,\gamma)$ sπ Cp

| | | | |
|---|---|---|---|
| 16† | 1.280 *10* | | |
| ~3† | ~1.5 | 37.4† | 4.930 *10* |
| ~3† | ~1.7 | 2.3† | 5.118* *15* |
| 12.8† | 2.100 *10* | 1† | 6.041 *50* |

Continued

$Si_{14}^{29}$ Continued

| | | | |
|---|---|---|---|
| 36.5† | 3.547 *10* | 9.2† | 6.354 *15* |
| 3.2† | 3.667 *20* | 6.1† | 7.224 *30* |
| 4.2† | 3.976 *20* | 1.6† | 8.482 *15* |

No 2.69 $\gamma$ Study covered $E_\gamma$ = 0.25 to 11
†Photons/100 Si captures ($\sigma_a$ = 0.091)
(Max in $Si^{29}$, $Si^{30}$, $Si^{31}$ = 82†, 14†, 4†)
Isotopic assignments from intensities and energetics *May also be in $Si^{30}$

56A37 B.P.Adyasevich, L.V.Groshev, A.M. Demidov, J. Nuclear Energy 3, 258 (1956); Soviet J. Atomic Energy No. 2, 40 (1956).

$Si_{14}^{30}$ Capture $\gamma$'s $Si^{(29)}(th\ n,\gamma)$ sπ Cp

| | |
|---|---|
| ~3† | ~3.8 |
| 2.3† | 5.118* *15* |
| 1.4† | 6.758 *20* |
| 0.2† | 10.59 *3* |

†Photons/100 Si captures ($\sigma_a$ = 0.091)
(Max in $Si^{29}$, $Si^{30}$, $Si^{31}$ = 82†, 14†, 4†)
Isotopic assignments from intensities and energetics
*May also be in $Si^{29}$

56A37 B.P.Adyasevich, L.V.Groshev, A.M. Demidov, J. Nuclear Energy 3, 258 (1956); Soviet J. Atomic Energy No. 2, 40 (1956).

$P_{15}^{29}$ Levels $Si^{(28)}(p,p)$ $E_p$ = 1.4 to 3.8

| $E_o$ | Level | $\Gamma$(kev) | J | EA |
|---|---|---|---|---|
| 1.66 | 4.33 | 60 | $3/2^-$ | 53°, 88°, 140°, 167° |
| 2.09 | 4.74 | 25 | $1/2^+$ | |
| 2.88 | 4.50 | 600 | $1/2^-$ | |
| 3.10 | 5.72 | ~12 | $5/2^-$ | $(7/2^-?)$ |
| 3.34 | 5.95 | ~12 | $3/2^+$ | $(5/2^+?)$ |

57V24 J.Vorona, J.W.Olness, W.Haeberli, H.W.Lewis, Bull. Am. Phys. Soc. 2, No. 1, 34 K11 (1957); verbal report.

$P_{15}^{30}$ $\gamma(Si^{30})$ $Al^{27}(\alpha,n)$
2.5m ~0.5% (2.24) scin $\gamma$,
From $P^{30}$ to $K^{38}$ $\gamma$ and $\beta^+$ ratios GM $\beta^+$

56M67 H.Morinaga, E.Bleuler, Phys. Rev. 103, 1423 (1956); 99, 658A (1955).

$P_{15}^{30}$ Levels $S^{32}(d,\alpha)$ $E_d$ = 1.6 to 2.9

| | | |
|---|---|---|
| g.s. | Q = +4.831 *13* | |
| 0.693 | T = 0* | s 63°, 90° |
| 1.440 | | |
| 1.97 | | |

*From yield comparable to that of g.s.

56L43 L.L.Lee, F.P.Mooring, Phys. Rev. 104, 1342 (1956); Bull. Am. Phys. Soc. 1, No. 6, 281 B8 (1956).

$P_{15}^{34}$ $S^{(34)}(fast\ n,p)$
$12^s$ $\gamma(S^{34})$ (2.10) scin
~0.2% 4.0
No 3.22$\gamma$ (<0.4%)

56M67 H.Morinaga, E.Bleuler, Phys. Rev. 103, 1423 (1956); 99, 658A (1955).

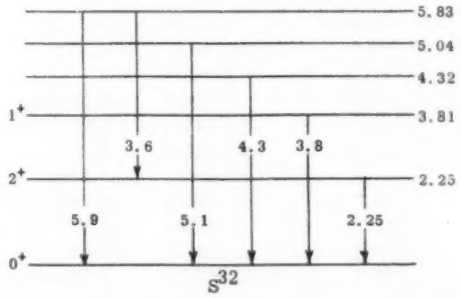
**$S^{31}$** 16 15 — Levels — $P^{31}(p,n)$ — $E_p = 17.2$ [ppl, 5 angles]

| g.s. | $Q = -6.06$ *20* |
|---|---|
| **1.15** *15* | |
| **2.28** *20* | |
| **3.35** *20* | |
| ~3.6? | |
| **4.51** *15* | (2 unresolved levels?) |
| **5.94** *30* | |
| **6.41** *20* | |

56R50 A.G.Rubin, G.D.Johnson, J.B.Reynolds, Phys. Rev. 104, 1444 (1956); 98, 1185A (1955).

**$S^{32}$** 16 16 — Levels — $P^{31}(p,\gamma)$ — $E_p = 0.4$ to 2.0 scin

| Γ(kev) | Level | γ's |
|---|---|---|
| 34 | **9.295** | |
| | **9.378** | |
| 17 | **9.481** | |
| 15 | **9.643** | |
| 9 | **9.720** | |
| <5 | **9.857** | |
| 6 | **9.891** | |
| | **9.922** | |
| 5 | **9.944** | 2.25, 3.8, 4.3, 7.7 |
| 9 | **10.044** | 2.25, 3.8, 7.7 |
| 15 | **10.206** | 2.25, 5.1, 7.9, 10 |
| 12 | **10.238** | 2.25, 3.6, 5.9? |
| 6 | **10.279** | 2.25, 8, 10 |
| 14 | **10.325** | |
| 7 | **10.366** | 2.25, 3.6?, 3.8, 4.3, 5.9, 8 |
| 5 | **10.391** | 2.25, 3.8, 8.1 |
| | **10.672** | |
| | **10.697** | |
| | **10.755** | |




56K30 B.D.Kern, L.W.Cochran, Phys. Rev. 104, 711 (1956); 99, 645A (1955).

**$S^{33}$** 16 17 — Resonance — $S^{(32)}(n,n)$ — $n,n(\theta)$

| $E_o$ | $J$ | $l_n$ | Γ(kev) |
|---|---|---|---|
| **(0.585)** | ≥5/2 | ≥2 | 1* |

*Used $J = 5/2$ and $l_n = 2$

56L35 R.O.Lane, J.E.Monahan, Bull. Am. Phys. Soc. 1, No. 7, 346 X5 (1956).

**Cl** 17 — Relative isotopic abundances — ms

No $Cl^{31}$, $Cl^{32}$, $Cl^{33}$, $Cl^{34}$ (<0.02%)
No $Cl^{36}$, $Cl^{38}$ (<0.07%)

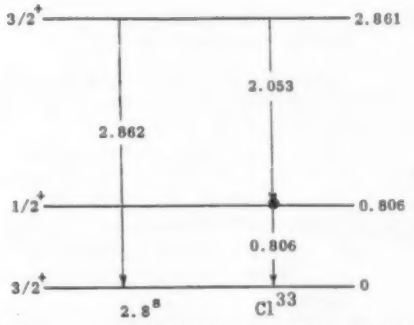
56K38 L.Kerwin, D.E.McElcheran, Can. J. Phys. 34, 1497 (1956).

**$Cl^{33}$** 17 16 — Capture γ's — $S^{(32)}(p,\gamma)$ — scin; $p,\gamma(\theta)$

2.86 level $J = 3/2^+$ $E_p = 0.594$ *5*

| | | |
|---|---|---|
| 50† | **0.806** *4* | |
| 49† | **2.053** *15* | E2/M1 = 0.005 *3* or 4.1 *6* |
| 51† | **2.862** *15* | E2/M1 = 0.10 *1* or 500 *200* |

(0.806γ)(2.053γ) No (0.806γ)(2.862γ)
$\Gamma_p\Gamma_\gamma/(\Gamma_p+\Gamma_\gamma) = 0.10$ *3* ev
$p,\gamma(\theta)$ consistent with $J = 3/2^+$ and $1/2^+$ for g.s. and 0.806 level in $Cl^{33}$ resp.




56V23 C. van der Leun, P.M.Endt, Physica 22, 1234 (1956).

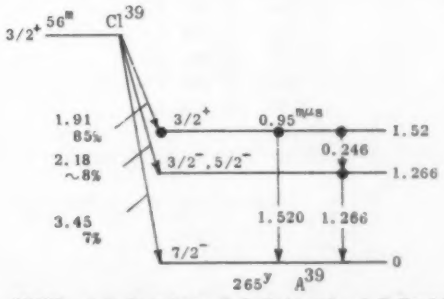
**$Cl^{34}$** 17 17 32m — $\gamma(S^{34})$ — **(1.14)** **(2.10)** ~0.2% **(3.22)** **(4.0)** — scin

56M67 H.Morinaga, E.Bleuler, Phys. Rev. 103, 1423 (1956); Phys. Rev. 99, 658A (1955).

**$Cl^{39}$** 17 22 56m — $A^{(40)}$(37-Mev α, αp) chem

| | | | | |
|---|---|---|---|---|
| $\beta^-$ | 85% | **1.91** ? | F-K linear | sl |
| | ~8% | **2.18** | | |
| | 7% | **3.45** *2* | $\Delta J = 2$, yes shape | |
| $\gamma(A^{39})$ | 90† | **0.246** *3* | $\alpha < 0.0021$ | scin, sl ce |
| | 100† | **1.266** *10* | $\alpha < 0.0016$ | |
| | 85† | **1.520** *10* | $\alpha < 0.0032$ | |

No γ with $E_\gamma > 1.52$ (<0.65†)
$(1.91\beta)(1.266,\ 1.520\gamma)$ delay = $0.95^{m\mu s}$ *5* scin
$(1.91\beta)(0.246\gamma)$ No $(3.45\beta)\gamma$
$(0.246\gamma)(1.266\gamma)$ delay < $0.5^{m\mu s}$ No $(1.520\gamma)\gamma$




56P38 J.R.Penning, H.R.Maltrud, J.C.Hopkins, F.H.Schmidt, Phys. Rev. 104, 740 (1956); Bull. Am. Phys. Soc. 1, No. 4, 162 B2 (1956).

**A** 18

Relative isotopic abundances ms

No $A^{34}$, $A^{35}$, $A^{39}$, $A^{41}$, $A^{43}$ (<0.01%)

56K32 L.Kerwin, Can. J. Phys. 34, 1080 (1956).

**$A^{35}$** 18 17 $1.8^{s}$

| | | | |
|---|---|---|---|
| $\tau$ | | $1.83^{s}$ 3 | $Cl^{(35)}$(10-Mev p,n) |
| $\beta^+$ | ~7% | (3.23)* | sl |
| | | (3.77)* | |
| | ~93% | 4.96 4 | |
| $\gamma(Cl^{35})$ | | | |
| | ~3† | 1.19 4 | scin |
| | 1† | 1.73 4 | |

*Energy inferred from $E_\gamma$

56K29 O.C.Kistner, A.Schwarzschild, B.M. Rustad, Phys. Rev. 104, 154 (1956); Bull. Am. Phys. Soc. 1, No. 1, 30 H3 (1956).

**$A^{41}$** 18 23 $1.8^{h}$

| | | | |
|---|---|---|---|
| $\tau$ | | $1.85^{h}$ 2 | $A^{(40)}$(pile n,$\gamma$) |
| $\beta^-$ | 99.1% | 1.199 8 | F-K linear ($E_\beta$>0.15) |
| | 0.88% | 2.48 4 | $\Delta J = 2$, yes shape s$\pi$, sl |
| $\gamma(K^{41})$ | | 1.290 5 | scin |

56S97 A.Schwarzschild, B.M.Rustad, C.S.Wu, Phys. Rev. 103, 1796; Bull. Am. Phys. Soc. 1, No. 1, 30 H4 (1956).

**K** 19

Relative isotopic abundances ms

| | |
|---|---|
| $K^{39}$ | 93.13% 5 |
| $K^{40}$ | 0.01174% 4 |
| $K^{41}$ | 6.86% 5 |

56R35 C.Reuterswärd, Arkiv Fysik 11, 1 (1956).

**$K^{39}$** 19 20

Ground state

| | | |
|---|---|---|
| q | +0.07 2 | M |

56B119 P.Buck, I.I.Rabi, B.Senitzky, Phys. Rev. 104, 553 (1956).

**$K^{43}$** 19 24 $22^{h}$

| | | | |
|---|---|---|---|
| $\gamma(Ca^{43})$ | | | $A^{(40)}$($\alpha$,p) |
| | <5† | 0.220 5 | scin |
| | 100† | 0.371 2 | scin, sl pe |
| | 14† | 0.388 2 | |
| | 16† | 0.394 2 | |
| | 23† | 0.591 3 | |
| | 91† | 0.614 4 | |
| | 3.5† | 1.005 10 | scin |

(~0.37$\gamma$)(0.220, ~0.37, ~0.60, 1.005$\gamma$)

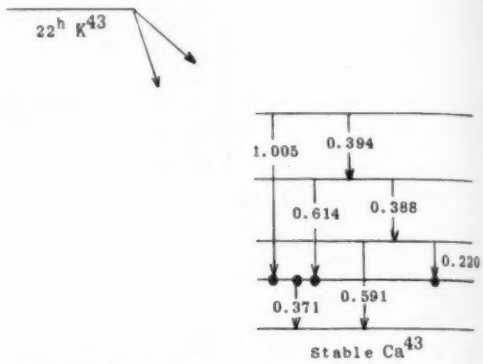
(~0.60$\gamma$)(~0.37$\gamma$) (1.005$\gamma$)(~0.37$\gamma$)

57B41 N.Benczer-Koller, A.Schwarzschild, C.S.Wu, Bull. Am. Phys. Soc. 2, No. 1, 23 G2 (1957); verbal report.

Continued

**$K^{43}$** 19 24 $22^{h}$

Continued




57B41 N.Benczer-Koller, A.Schwarzschild, C.S. Wu, Bull. Am. Phys. Soc. 2, No. 1, 24 G2 (1957).

**$_{20}Ca$**

Level $Ca(n,n')$ $E_n = 4.4$

g.s. $\sigma(90°) = 49$ 12 mb/sr ppl

No level observed below 3.35

56W36 J.B.Weddell, Phys. Rev. 104, 1069 (1956).

**$Ca^{40}$** 20 20

Level $Ca^{(40)}(n,n'+e^+e^-)$ pulsed n's

(3.35) $\tau = 2.4^{m\mu s}{}^{+1.5}_{-3}$ scin $\gamma^{\pm}$

57K29 R.M.Kloepper, R.B.Day, D.A.Lind, Bull. Am. Phys. Soc. 2, No. 1, 60 U6 (1957); verbal report.

**$Ca^{41}$** 20 21

Levels $Ca^{(40)}$(d,p) $E_d = 2.5$ to 7.0

| | | | |
|---|---|---|---|
| g.s. | Q = 6.140 9 | | s 90° |
| 1.947 4 | | | |
| 2.014 5 | 3.206 6 | 3.837 7 | |
| 2.469 5 | 3.375 7 | 3.854 7 | |
| 2.584 6 | 3.405 7 | 3.921 7 | |
| 2.612 6 | 3.500 7 | 3.950 7 | |
| 2.677 6 | 3.531 7 | 3.982 7 | |
| 2.890 6 | 3.619 7 | 4.023 7 | |
| 2.967 6 | 3.682 7 | 4.101 7 | |
| 3.056 6 | 3.736 7 | 4.194 7 | |

56B102 C.M.Braams, Phys. Rev. 103, 1310 (1956).

**$Ca^{47}$** 20 27 $4.7^{d}$

| | | | |
|---|---|---|---|
| $\tau$ | | $4.7^{d}$ 1 | $Ca^{46}$(pile n,$\gamma$) chem |
| | | | V(380-Mev p) chem |
| $\beta^-$ | 83% | 0.66 1 | sl |
| | 17% | 1.94 2 | |
| $\gamma(Sc^{47})$ | 1† | 0.48 2 | scin |
| | 1† | 0.83 2 | |
| | 13† | 1.31 2 | |

(0.48$\gamma$)(0.83$\gamma$) No(1.31$\gamma$)$\gamma$

No $\beta$ with $E_\beta$ = 1.0 to 1.5 (<3%)

56L38 L.J.Lidofsky, V.K.Fischer, Phys. Rev. 104, 759 (1956); 99, 658A (1955).

$Sc^{45}$ 21 24

Levels — $Sc^{45}(p,p')$ — $E_p$ = 4.5, 5.0, 5.6

| | | |
|---|---|---|
| | sπ 180° | |
| 0.377 3 | | |
| 0.541 3 | | |
| 0.722 5 | 1.235 5 | |
| 0.860? | 1.409 5 | |
| 0.972 4 | 1.432 5 | |
| 1.06 ? | 1.661 5 | |

56W30 P.M.Windham, C.R.Gossett, G.C. Phillips, J.P.Schiffer, Phys. Rev. 103, 1321 (1956); 99, 655A (1955).

$Sc^{46}$ 21 25

84$^d$ g.s.

τ — 84.1$^d$ 3 — $Ti^{(46)}$(pile n,p) chem

56S87 R.P.Schuman, M.E.Jones, A.C.Newherter, J. Inorg. Nucl. Chem. 3, 160 (1956).

τ — 82.9$^d$ 16 — $Co^{59}$(170-Mev p) chem

56R45 G.Rudstam, Thesis, Univ. Uppsala, 1956.

$Sc^{47}$ 21 26

3.4$^d$

| | | | |
|---|---|---|---|
| τ | | 3.3$^d$ 1 | d 4.7$^d$Ca chem |
| $\beta^-$ | 74% | 0.450 10 | sl |
| | 26% | 0.610 5 | |
| γ($Ti^{47}$) | | 0.160 5 | scin |
| (0.450β)(0.160γ) | | No | (0.610β)(0.160γ) scin |

56L39 L.J.Lidofsky, V.K.Fischer, Phys. Rev. 104, 759 (1956); 99, 658A (1955).

Ti 22

Capture γ's — Ti(th n,γ)

| | | | | sπ Cp |
|---|---|---|---|---|
| 24† | 0.350* 5 | | | |
| 5.7† | 1.03* 2 | 2.1† | 3.86* 2 | |
| 2.8† | 1.18 2 | 0.6† | 4.30? 6 | |
| 85† | 1.390* 5 | 2† | 4.68* 3 | |
| 5.2† | 1.51* 1 | 5.2† | 4.875* 20 | |
| 13† | 1.60* 1 | 2.7† | 4.96* 2 | |
| 7.5† | 1.78* 2 | 0.8† | 5.67* 6 | |
| 2.4† | 2.08* 3 | 27.5† | 6.42* 2 | |
| 2.85† | 2.22* 3 | 4† | 6.56* 3 | |
| 1.5† | 2.83* 4 | 38† | 6.756* 10 | |
| 1.5† | 2.95* 4 | 0.6† | 7.16 5 | |
| 2.8† | 3.02* 4 | 0.3† | 7.66 4 | |
| 1.3† | 3.20 4 | 0.2† | 8.31$ 5 | |
| 2.6† | 3.39* 3 | 0.13† | 9.17$ 7 | |
| 1.2† | 3.50* 3 | 0.09† | 9.39$ 5 | |
| 2.4† | 3.65* 2 | 0.01† | 10.47$ 15 | |

Study covered $E_\gamma$ = 0.25 to 12

†Photons/100 Ti captures ($\sigma_a$ = 5.8)

(Max in $Ti^{47}$, $Ti^{48}$, $Ti^{49}$, $Ti^{50}$, $Ti^{51}$ = 0.7†, 2.2†, 95†, 1.7†, 0.3†)

*Assigned to $Ti^{49}$

$Assigned to $Ti^{48}$. 9.39γ may also be in $Ti^{50}$

56A37 B.P.Adyasevich, L.V.Groshev, A.M. Demidov, J. Nuclear Energy 3, 258 (1956); Soviet J. Atomic Energy No. 2, 40 (1956).

$Ti^{46}$ 22 24

Level — $Ti^{46}(\alpha,\alpha'\gamma)$ — $E_\alpha$ = 6

0.890 9 — τ = 9.0 μμs 14 — scin γ

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 99, 617A (1955).

$V^{47}$ 23 24

31$^m$

τ — 32.0$^m$ 3 — $Co^{59}$(170-Mev p) chem

56R45 G.Rudstam, Thesis, Univ. Uppsala, 1956.

$Ti^{47}$ 22 25

Reaction γ's — $Ti^{47}(\alpha,\alpha'\gamma)$ — $E_\alpha$ = 1.2 to 3.4

0.160 2 — εB(E2) = 0.040 6 scin γ

0.730* 7

1.02* 1

*May be due to (α,nγ) or (α,pγ) reactions

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 96, 426; 93, 351 (1954).

$Ti^{48}$ 22 26

Level — $Ti^{48}(\alpha,\alpha'\gamma)$ — $E_\alpha$ = 6

0.99 1 — τ = 9.7 μμs 15 — scin γ

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 99, 617A (1955).

Capture γ's — $Ti^{(47)}$(th n,γ) — sπ Cp

| | | | | |
|---|---|---|---|---|
| 0.2† | 8.31 5 | 0.09† | 9.39* 5 | |
| 0.13† | 9.17 7 | 0.01† | 10.47 15 | |

†Photons/100 Ti captures ($\sigma_a$ = 5.8)

(Max in $Ti^{47}$, $Ti^{48}$, $Ti^{49}$, $Ti^{50}$, $Ti^{51}$ = 0.7† 2.2†, 95†, 1.7†, 0.3†)

Isotopic assignments from intensities and energetics

*May also be in $Ti^{50}$

56A37 B.P.Adyasevich, L.V.Groshev, A.M. Demidov, J. Nuclear Energy 3, 258 (1956); Soviet J. Atomic Energy No. 2, 40 (1956).

$Ti^{49}$ 22 27

Capture γ's — $Ti^{(48)}$(th n,γ) — sπ Cp

| | | | | |
|---|---|---|---|---|
| 24† | 0.350 5 | 2.6† | 3.39 3 | |
| 5.7† | 1.03 2 | 1.2† | 3.50 3 | |
| 85† | 1.390 5 | 2.4† | 3.65 2 | |
| 5.2† | 1.51 1 | 2.1† | 3.86 2 | |
| 13† | 1.60 1 | 2† | 4.68 3 | |
| 7.5† | 1.78 2 | 5.2† | 4.875 20 | |
| 2.4† | 2.08 3 | 2.7† | 4.96 2 | |
| 2.85† | 2.22 3 | 0.8† | 5.67 6 | |
| 1.5† | 2.83 4 | 27.5† | 6.42 2 | |
| 1.5† | 2.95 4 | 4† | 6.56 3 | |
| 2.8† | 3.02 4 | 38† | 6.756 10 | |

Study covered $E_\gamma$ = 0.25 to 12

†Photons/100 Ti captures ($\sigma_a$ = 5.8)

(Max in $Ti^{47}$, $Ti^{48}$, $Ti^{49}$, $Ti^{50}$, $Ti^{51}$ = 0.7†, 2.2†, 95†, 1.7†, 0.3†)

Isotopic assignments from intensities and energetics

56A37 B.P.Adyasevich, L.V.Groshev, A.M. Demidov, J. Nuclear Energy 3, 258 (1956); Soviet J. Atomic Energy No. 2, 40 (1956).

Reaction γ — $Ti^{49}(\alpha,\alpha'\gamma)$ — $E_\alpha$ = 6

1.44 14 — scin

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956).

$V^{47}$ 23 24 31$^m$

$Sc^{45}$(30-Mev $\alpha$, 2n)

No 0.160$\gamma$ ($<0.8\%$) scin $\gamma,\gamma\gamma^{\pm}$

56L39 L.J.Lidofsky, V.K.Fischer, Phys. Rev. 104, 759 (1956).

$V^{48}$ 23 25 16$^d$

$Cr^{(50)}$($\leq$15-Mev d, $\alpha$) chem

$\tau$ **15.99$^d$** *8*

56K33 P.Kafalas, J.W.Irvine, Jr., Phys. Rev. 104, 703 (1956).

$\tau$ **16.18$^d$** *5* $Co^{59}$(170-Mev p) chem

56R45 G.Rudstam, Thesis Univ. Uppsala (1956).

$V^{49}$ 23 26 330$^d$

$\tau$ **327$^d$** *20* $Ti^{(48)}$(15-Mev d,n) chem

$E_\epsilon$ **0.621** *10* scin $\gamma$-continuum

Shape of continuous $\gamma$ spectrum agrees with predictions of Glauber and Martin•

No $\gamma$ ($<10^{-3}\%$)

56H59 R.W.Hayward, D.D.Hoppes, Phys. Rev. 104, 183 (1956); 99, 659A (1956); •R.J. Glauber, P.C.Martin, Phys. Rev. 104, 158 (1956).

$V^{49}$ 23 26

330$^d$ ground state $V^{49}/V^{51}\sim0.005$

J **7/2** para

$|\mu|$ **4.46**

$|\mu(V^{49}/\mu(V^{51})| = 0.867$ *10*

57W17 M.M.Weiss, R.I.Walter, O.R.Gilliam, V.W.Cohen, Bull. Am. Phys. Soc. 2, No. 1, 31 JA9 (1957).

$V^{50}$ 23 27

Reaction $\gamma$ $V^{50}(\alpha,\alpha'\gamma)$ $E_\alpha$=6.5; scin $\gamma$

**0.225** 2 $\epsilon B(E2) = 0.011$ 2

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); Bull. Am. Phys. Soc. 1, No. 4, 164, C3 (1956).

Reaction $\gamma$ $V^{50}(\alpha,\alpha'\gamma)$ $E_\alpha$=4.4; scin $\gamma$

**0.226** 2 $\epsilon B(E2) = 0.011$ 2

56F29 L.W.Fagg, E.H.Geer, E.A.Wolicki, Phys. Rev. 104, 1073 (1956); Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956).

$Cr^{51}$ 24 27 28$^d$

$\tau$ **27.8$^d$** *1* $Cr^{(50)}$(pile n,$\gamma$) chem

56S87 R.P.Schuman, M.E.Jones, A.C.Mewherter, J. Inorg. Nucl. Chem. 3, 160 (1956).

$\tau$ **27.9$^d$** 2 Cr($\leq$15-Mev d) chem

56K33 P.Kafalas, J.W.Irvine, Jr., Phys. Rev. 104, 703 (1956).

$Cr^{52}$ 24 28

Levels $Cr^{(52)}(n,n')$ $E_n$=4.4 ppl 90°

| $\sigma$(mb/sr) | Level |
|---|---|
| 14 5 | (1.45) |
| 5 2.5 | (2.43) |
| 14 7 | (3.13) |

56W36 J.B.Weddell, Phys. Rev. 104, 1069 (1956); Bull. Am. Phys. Soc. 1, No. 1, 55 R5 (1956).

$Cr^{53}$ 24 29

Resonances $Cr^{(52)}$(n) $E_n$=1 to 410 kev

| $E_o$(kev) | $\Gamma$(kev) | $E_o$(kev) | $\Gamma$(kev) |
|---|---|---|---|
| **51** | 1.2 | | |
| **97.5** | 3.0 | **152** | 1.0 |
| **120.4** | 0.6 | **243** | 1.5 |
| **138** | 1.0 | **325** | 2.5 |
| **142** | 1.2 | **366** | 2.5 |
| **146** | 0.9 | **406** | 4.5 |

56H60 C.T.Hibdon, Bull. Am. Phys. Soc. 1, No. 7, 347 X6 (1956); verbal report.

$Cr^{56}$ 24 32

$\tau$ **$<1.3^h$** or **$>210^y$** Cr,Ni,Cu(350-Mev p) chem

56J32 J.W.Jones, NYO-6627 (1956).

Mn 25

Relative isotopic abundances ms

No $Mn^{51}$, $Mn^{52}$, $Mn^{56}$, $Mn^{58}$, $Mn^{59}$, $Mn^{60}$ ($<0.01\%$)

56K32 L.Kerwin, Can. J. Phys. 34, 1080 (1956).

$Mn^{52}$ 25 27 5.7$^d$ g.s.

$Cr^{(52)}$ ($\leq$15-Mev d,2n)chem

$\tau$ **5.69$^d$** *3*

56K33 P.Kafalas, J.W.Irvine,Jr., Phys. Rev. 104, 703 (1956).

$Mn^{55}$(170-Mev p) chem

$\tau$ **5.82$^d$** *6*

56R45 G.Rudstam, Thesis Univ. Uppsala (1956).

$Mn^{53}$ 25 28

140$^y$ ground state Cr(18-Mev d) chem

J **7/2** para

$|\mu|$ **5.050** *7*

$|\mu(Mn^{53})/\mu(Mn^{55})| = 1.455$ 2

56D45 W.Dobrowolski, R.V.Jones, C.D.Jeffries, Phys. Rev. 104, 1378 (1956).

$Mn^{54}$ 25 29 291$^d$ g.s.

$\tau$ **278$^d$** *5* $Fe^{(54)}$(pile n,p) chem

56S87 R.P.Schuman, M.E.Jones, A.C.Mewherter, J. Inorg. Nucl. Chem. 3, 160 (1956).

$\tau$ **290$^d$** *6* Cr($\leq$15-Mev d) chem

56K33 P.Kafalas, J.W.Irvine, Jr., Phys. Rev. 104, 703 (1956).

$Mn^{55}$ 25 30

Level $Mn^{55}(p,p')$ $E_p$ = 4.8 to 5.5
**0.128** *7* sπ 180°

56W30 P.M.Windham, C.R.Gossett, G.C.Phillips, J.P.Schiffer, Phys. Rev. 103, 1321 (1956); 99, 655A (1955).

Reaction γ $Mn^{55}(p,p'\gamma)$ $E_p$ = 1.75
**0.128** *1* εB(E2) = 0.0009 *2* sd $ce_K$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction γ $Mn^{55}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 1.0 to 3.5
$Mn^{55}(p,p'\gamma)$ $E_p$ = 0.75
**0.128** εB(E2) = 0.075 scin γ

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 93, 351; 96, 426 (1954).

$Mn^{56}$ 25 31 $2.6^h$

γ($Fe^{56}$)

| | | | | |
|---|---|---|---|---|
| 100† | **0.845** | | | scin |
| 29† | **1.3** | 0.67† | **2.69** | |
| 15† | **2.1** | 0.35† | **2.93** | |
| 1.02† | **2.56** | 0.2† | **3.2** | |

57S48 C.S.Cook, F.M.Tomnovec, Bull. Am. Phys. Soc. 2, 24 G3 (1957); verbal report.

Fe 26

Capture γ's Fe(th n,γ) sπ Cp

| | | | | |
|---|---|---|---|---|
| 3.2† | **0.313** *6* | 1.1† | **3.725*** *25* | |
| 6.7† | **0.364*** *8* | 2.3† | **3.844** *15* | |
| 4.1† | **0.454** *10* | 1.4† | **4.034** *20* | |
| 1.5† | **1.236*** *12* | 4.3† | **4.220*** *15* | |
| 1.9† | **1.530*** *15* | 2.2† | **4.405*** *15* | |
| 6.1† | **1.626*** *12* | 2.1† | **4.805*** *15* | |
| 6.4† | **1.720*** *10* | 0.9† | **4.940** *20* | |
| 2.3† | **1.802*** *15* | 0.6† | **5.510*** *25* | |
| 1.4† | **2.143*** *10* | 8.7† | **5.925*** *25* | |
| 1† | **2.672** *20* | 7.9† | **6.026*** *15* | |
| 2.9† | **2.730** *15* | 0.7† | **6.430*** *25* | |
| 2.1† | **2.837*** *15* | 5.3† | **7.275*** *15* | |
| 2.1† | **3.146** *25* | 31.5† | **7.636*** *10* | |
| 2.9† | **3.240*** *15* | 0.2† | **8.342** *60* | |
| 3.9† | **3.430*** *15* | 0.3† | **8.86**§ *6* | |
| 1.4† | **3.552*** *20* | 2.7† | **9.295**§ *15* | |

Study covered $E_\gamma$ = 0.25 to 11
†Photons/100 Fe captures ($\sigma_a$ = 2.43)
(Max in $Fe^{55}$,$Fe^{57}$,$Fe^{58}$,$Fe^{59}$ = 5†,93†,2†,~0.1†)
*Assigned to $Fe^{57}$
§Assigned to $Fe^{55}$. 9.295γ may also be in $Fe^{58}$

56A37 B.P.Adyasevich, L.V.Groshev, A.M. Demidov, J. Nuclear Energy 3, 258 (1956); Soviet J. Atomic Energy No. 2, 40 (1956).

$Fe^{54}$ 26 28

Level $Fe^{54}(p,p')$ $E_p$ = 4.63
**1.413** *5* sπ 180°

56W30 P.M.Windham, C.R.Gossett, G.C.Phillips, J.P.Schiffer, Phys. Rev. 103, 1321 (1956); 99, 655A (1955).

$Fe^{55}$ 26 29 $2.9^y$

τ **2.60**$^y$ *2* $Fe^{54}$(pile n,γ)

56S87 R.P.Schuman, M.E.Jones, A.C.Mewherter, J. Inorg. Nucl. Chem. 3, 160 (1956).

$Fe^{56}$ 26 30

Level $Fe^{56}(p,p')$ $E_p$ = 4.5 to 5.7
**0.845** *5* sπ 180°

56W30 P.M.Windham, C.R.Gossett, G.C. Phillips, J.P.Schiffer, Phys. Rev. 103, 1321 (1956); 99, 655A (1955).

Levels $Fe^{(56)}(n,n')$ $E_n$ = 4.4

| σ(90°) | Level | σ(90°) | Level | |
|---|---|---|---|---|
| 17.5 *44* | **(0.85)** | | | ppl 90° |
| 7.6 *27* | **(2.09)** | <2.2 | **(3.02)** | |
| 5.5 *22* | **(2.60)** | 4.4 *22* | **(3.26)** | |
| | **(2.87)** | | | |

σ units: mb/sterad

56W31 J.B.Weddell, Bull. Am. Phys. Soc. 1, No. 7, 339 P8 (1956); verbal report.

Level $Fe^{56}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 4.0 to 6.5
**0.850** *9* $\tau = 6.0^{\mu\mu s}$ *9* scin γ

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 99, 617A (1955).

Level $Fe^{(56)}(\gamma,\gamma)$ $Mn^{56}$ source
**(0.85)** $\tau > 5.5^{\mu\mu s}$

β recoil of $2.6^h Mn^{56}$ source in liquid state utilized to compensate for γ recoil

54I02 K.Ilakovac, Proc. Phys. Soc. 67A, 601 (1954).

Reaction γ's $Fe^{(56)}(n,n'\gamma)$ $E_n$ = 14 scin

| σ | $E_\gamma$ |
|---|---|
| 0.75 *8* | **0.85** |
| 0.26 *3* | **1.25** |
| | **1.82** |
| | **2.12** |

55M99 G.W.McClure, D.W.Kent, J.Franklin Inst. 260, 238 (1955).

$Fe^{57}$ 26 31

Reaction γ's $Fe^{57}(p,p'\gamma)$ $E_p$ = 1.75
0.137 level sd $ce_K$
**0.122** *1* εB(E2) = 0.0007 *4*
**0.137** *1* = 0.0004 *2*

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction γ $Fe^{57}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 1.0 to 3.5
0.137 level scin γ
**0.122** εB(E2) = 0.057

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 93, 351; 96, 426 (1954).

$Fe^{57}$ 26 31

Capture $\gamma$'s $Fe^{(56)}$(th n, $\gamma$) sm Cp

| | | | | |
|---|---|---|---|---|
| 6.7† | **0.364** *8* | 1.1† | **3.725** *25* | |
| 1.5† | **1.236** *12* | 4.3† | **4.220** *15* | |
| 1.9† | **1.530** *15* | 2.2† | **4.405** *15* | |
| 6.1† | **1.626** *12* | 2.1† | **4.805** *15* | |
| 6.4† | **1.720** *10* | 0.6† | **5.510** *25* | |
| 1.4† | **2.143** *10* | 8.7† | **5.925** *25* | |
| 2.1† | **2.837** *15* | 7.9† | **6.026** *15* | |
| 2.9† | **3.240** *15* | 0.7† | **6.430** *25* | |
| 3.9† | **3.430** *15* | 5.3† | **7.275** *15* | |
| 1.4† | **3.552** *20* | 31.5† | **7.636** *10* | |

Study covered $E_\gamma$ = 0.25 to 11

†Photons/100 Fe captures ($\sigma_a$ = 2.43)
(Max in $Fe^{55}$,$Fe^{57}$,$Fe^{58}$,$Fe^{59}$ = 5†, 93†, 2†, ~0.1†)
Isotopic assignments from intensities and energetics

56A37 B.P.Adyasevich, L.V.Groshev, A.M. Demidov, J. Nuclear Energy 3, 258 (1956); Soviet J. Atomic Energy No. 2, 40 (1956).

Resonances $Fe^{(56)}$(n) $E_n$ = 1 to 410 kev

| $E_0$(kev) | $\Gamma$(kev) | $E_0$(kev) | $\Gamma$(kev) |
|---|---|---|---|
| **29.17** | 1.0 | **188** | 0.95 |
| **75.6** | 0.9 | **219** | 0.55 |
| **85.5** | 1.0 | **272** | 2.2 |
| **127.7** | 0.6 | **316** | 3.5 |
| **138** | 0.825 | **360** | 4 |
| **145** | 0.8 | **388** | 8 |
| **162** | 0.875 | **406** | 5 |

56H60 C.T.Hibdon, Bull. Am. Phys. Soc. 1, No. 7, 347 X6 (1956); verbal report.

$Fe^{59}$ 26 33 45$^d$

$\tau$ **45.0$^d$** *2* differential ic

55T27 J.Tobailem, Ann. phys. 10, 783 (1955); Compt. rend. 233, 1360 (1951).

$\tau$ **47.1$^d$** *3* $As^{75}$(170-Mev p) chem

56R45 G.Rudstam, Thesis, Univ. Uppsala (1956).

$\beta\gamma$ and $\gamma\gamma$ delay < 100$^{\mu\mu s}$ scin

55B148 E.E.Berlovich, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 343 (1955), Columbia Tech. Transl. p.305.

$Fe^{60}$ 26 34

$\tau$ $<7^m$ or $>300^y$* Ni(350-Mev p) chem; $Fe^{(58)}$(pile 2n,$\gamma$) chem

*If $\sigma[Fe^{59}(n,\gamma)]$ = 1

56J32 J.W.Jones, NYO-6627 (1956).

$Co^{56}$ 27 29 77$^d$

$\gamma(Fe^{56})$ $Fe^{(56)}$(p,n) chem scin

| | | | |
|---|---|---|---|
| 100† | **0.845** | | |
| ~2† | **0.975** | 11.5† | **2.02** |
| 16† | **1.025** | 16† | **2.56** |
| 70† | **1.22** | 2† | **2.98** |
| 6† | **1.35** | 11.6† | **3.25** |
| 17† | **1.76** | 1.1† | **3.47** |

0.845$\gamma/\beta^+$ = 5.3 *2* scin $\gamma/\gamma^\pm$
No 1.5$\gamma$ (< 1†)

56S107 C.S.Cook, F.M.Tomnovec, Phys. Rev. 104, 1407 (1956); Bull. Am. Phys. Soc. 1, No. 1, 31 H8 (1956); 1, No. 5, 253 F7 (1956).

$Co^{57}$ 27 30 270$^d$

$Fe^{(56)}$(d,n) chem; sd

$\epsilon_L/\epsilon_K$ = 0.20 *13* from $e_{AK}/(e_K\ 0.014\gamma)$ = 1.48 *10*

56M85 A.Moussa, A.Juillard, Compt. rend. 243, 1515 (1956).

$Fe^{(56)}$(d,n) chem

| $\gamma(Fe^{57})$ | | K/L | L/M | sd ce |
|---|---|---|---|---|
| 465* *15* | **0.01437** *1* | 8.93 | 9.1 | |
| 10* | **0.12194** *3* | 6.7 | | |
| | **0.13631** *3* | 8.2 | | |

*Relative $ce_K$ intensity.

55B132 J.Bellicard, A.Moussa, Compt. rend. 241, 1202 (1955).

$Co^{58}$ 27 31 71$^d$ g.s.

$\tau$ **71.3$^d$** *2* $Ni^{(58)}$(pile n,p) chem

56S87 R.P.Schuman, M.E.Jones, A.C.Mewherter, J. Inorg. Nucl. Chem. 3, 160 (1956).

$\gamma(Fe^{58})$ $Ni^{(58)}$(n,p) chem scin

| | | |
|---|---|---|
| 100† | **(0.805)** | |
| 0.5† | **1.67** | |

0.805$\gamma/\beta^+$ = 6.9 *2* scin $\gamma/\gamma^\pm$
No 0.865$\gamma$ (< 2†)

56S107 C.S.Cook, F.M.Tomnovec, Phys. Rev. 104, 1407 (1956); Bull. Am. Phys. Soc. 1, No. 5, 253 F7 (1956).

$\gamma(Fe^{58})$ **(0.805)** E2 $\gamma(\theta,T)$
**(1.60)** E2

$\lambda$ = 0.11 *4* for $Co^{58}$ decay to $Fe^{58}$ 0.805 level
$\lambda$ = 0.45 *11* for $Co^{58}$ decay to $Fe^{58}$ 1.60 level

where $1/\lambda = 1 + \dfrac{(C_T^2+C_A^2)\,|\int\sigma|^2}{(C_S^2+C_V^2)\,|\int 1|^2}$

56G52 D.F.Griffing, J.C.Wheatley, Phys. Rev. 104, 389 (1956).

$Co^{59}$ 27 32

Levels $Co^{59}$(n,n') $E_n$ = 4.4

| $\sigma(90°)$ | Level | |
|---|---|---|
| 50 *10* | **g.s.** | ppl 90° |
| 19 *6* | **(1.10)** / **(1.29)** | $\sigma$ units: mb/sterad |

56W31 J.B.Weddell, Bull. Am. Phys. Soc. 1, No. 7, 339 P8 (1956); verbal report.

$Co^{60}$ 27 33
$5.2^{y}$ g.s.

No 2.51$\gamma$ ($<10^{-4}$%) D($\gamma$,n)

56E15 R.D.Edge, Australian J. Phys. 9, 429 (1956).

$Co^{60}$ 27 33

Resonance $Co^{59}$(n,$\gamma$) pulsed n's
(0.134 ev) $\sigma_o$= 10,000
If J= 4 $\sigma_o$= 10,600; if J= 3 $\sigma_o$= 8200

56L42 J.E.Lynn, E.R.Rae, quoted by V.L. Sailor, Phys. Rev. 104, 736 (1956); E.R.Rae, Proc. 1954 Glasgow Conf. on Nuclear and Meson Phys. Pergamon Press, London and New York (1955) p.71.

Ni 28

Levels Ni(n,n') $E_n$=4.4

| $\sigma$(90°) | Level | $\sigma$(90°) | Level | |
|---|---|---|---|---|
| 32 5 | g.s. | 4 *1.5* | (2.18) | ppl 90° |
| 11 *3* | {(1.33) (1.45)} | 5 2.5 | {(2.48) (2.51)} | |

$\sigma$ units: mb/sterad

56W31 J.B.Weddell, Bull. Am. Phys. Soc. 1, No. 7, 339 P8 (1956); verbal report.

$Ni^{57}$ 28 29 $36^{h}$

Fe(54)(56-Mev $\alpha$,n) chem
Ni(28-Mev d) chem

$\beta^+$ ~2† **0.35** *5* sl
22† **0.72** *3*
76† **0.854** *9*

$\gamma(Co^{57})$ 60† **0.1272** *5* $\alpha_K$=0.022 6 scin, K/LM=9 4 sl ce
11† **0.400** *20* scin
176† **1.363** *6*
28† **1.89** *2*

$\gamma^{\pm}$(0.1272, 1.363, 1.89$\gamma$)
(0.1272 $\gamma$)(1.363 $\gamma$)($\theta$) favors J=1/2, 3/2, 7/2 with E2/M1(0.1272$\gamma$) =0.0025 *25*
$\epsilon/\beta^+$=1.0 *1* from $\gamma/\gamma^{\pm}$
1.5 *3* from branching to $Co^{57}$ levels deduced from $\gamma$ intensities and theoretical $\epsilon/\beta^+$ of Feenberg-Trigg
No 1.49$\gamma$ ($<0.6^+$)
No (1.89 $\gamma$)(0.1272, 1.363$\gamma$)

56K28 J.Konijn, B.Van Nooijen, P.Mostert, P.M.Endt, Physica 22, 887 (1956).

$Ni^{58}$ 28 30

Level $Ni^{58}$(p,p') $E_p$=4.4 to 5.5
**1.453** *5* s$\pi$ 180°

56W30 P.M.Windham, C.R.Gossett, G.C. Phillips, J.P.Schiffer, Phys. Rev. 103, 1321 (1956); 99, 655A (1955).

$Ni^{59}$ 28 31

Levels $Co^{59}$(p,n) $E_p \leq 5$
g.s. Q= −1.857 *4* thresh n

| | |
|---|---|
| **0.343** *4* | |
| **0.441** *4* | **1.96** *2* |
| **1.22** *1* | **2.15** *2* |
| **1.343** *10* | **2.55** *2* |
| **1.790** *12* | **2.66** *2* |

56B112 J.W.Butler, K.L.Dunning, R.O. Bondelid, Bull. Am. Phys. Soc. 1, No. 7, 327 G7 (1956).

$Ni^{60}$ 28 32

Level $Ni^{60}$(p,p') $E_p$=4.4 to 5.5
**1.329** *5* s$\pi$ 180°

56W30 P.M.Windham, C.R.Gossett, G.C.Phillips, J.P.Schiffer, Phys. Rev. 103, 1321 (1956); 99, 655A (1955).

$Ni^{61}$ 28 33

Reaction $\gamma$'s $Ni^{61}(\alpha,\alpha'\gamma)$ $E_\alpha$=4.4; scin $\gamma$
**0.070** *1* $\epsilon$B(E2) =0.00038 *8*
**0.282** *3* =0.00090 *18*
**0.657** *7* =0.0094 *19*
No $\gamma\gamma$

56F29 L.W.Fagg, E.H.Geer, E.A.Wolicki, Phys. Rev. 104, 1073 (1956); Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956).

$Ni^{63}$ 28 35 $125^{y}$

$Ni^{62}$(pile n,$\gamma$) chem
$\tau$ $125^{y}$ *6* specific activity

56M95 C.C.McMullen, B.D.Pate, R.H.Tomlinson, L.Yaffe, Can. J. Chem. 34, 1742 (1956).

$Cu^{63}$ 29 34

Levels $Cu^{63}$(p,p') $E_p$=4.6,5.6
**0.669** *5* s$\pi$ 180°
**0.961** *5* **1.411** *5*
**1.325** *5* **1.546** *5*

56W30 P.M.Windham, C.R.Gossett, G.C. Phillips, J.P.Schiffer, Phys. Rev. 103, 1321 (1956); 99, 655A (1955).

Reaction $\gamma$'s $Cu^{63}(\alpha,\alpha'\gamma)$ $E_\alpha$=6
**0.690** *7* $\epsilon$B(E2) =0.010 2 scin $\gamma$
**0.990** *10* =0.029 4

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 100, 961A (1955).

$Cu^{64}$ 29 35 $13^{h}$

$\tau$ $12.90^{h}$ *6* $As^{75}$(49-Mev p) chem

56R45 G.Rudstam, Thesis, Univ. Uppsala 1956.

$\tau$ $12.80^{h}$ *3* differential ic

55T07 J.Tobailem, J. phys. radium 16, 48 (1955); Ann. phys. 10, 783 (1955).

$Cu^{65}$ 29 36

$Cu^{65}$(p,p') $E_p$=4.6,5.6
No level observed below 1.5 s$\pi$ 180°

56W30 P.M.Windham, C.R.Gossett, G.C. Phillips, J.P.Schiffer, Phys. Rev. 103, 1321 (1956); 99, 655A (1955).

Reaction $\gamma$'s $Cu^{65}(\alpha,\alpha'\gamma)$ $E_\alpha$=6.5; scin $\gamma$
**0.815** *8* $\epsilon$B(E2) =0.0087 *13*
**1.15** *1* =0.027 4

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956).

$Zn^{64}_{30\ 34}$ Level $Zn^{64}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$
**1.00** *1* $\tau = 2.6^{\mu\mu s}$ *4* scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956).

$Zn^{66}_{30\ 36}$ Level $Zn^{(66)}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$
**1.04** *1* $\tau = 2.8^{\mu\mu s}$ *4* scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 100, 961A (1955).

$Zn^{67}_{30\ 37}$ $Zn^{(66)}(\text{th n},\gamma)$
(capture $\gamma$)(0.09$\gamma$) delay = $8.5^{\mu s}$ scin

56P40 J.M.Ponce de Léon, C.Sánchez del Río, Anales real soc. españ. fis. y quim. 52A, 137 (1956).

Reaction $\gamma$'s $Zn^{67}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.5$
0.182 level scin $\gamma$
**0.090** (2 unresolved $\gamma$'s)
**0.182** *2* $\epsilon B(E2) = 0.032$ *5*

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 96, 426; 93, 351 (1957).

$Zn^{69}_{30\ 39}$ $58^m$ g.s. $\tau$ **58.5**$^m$ *12* $As^{75}$(170-Mev p) chem

56R45 G.Rudstam, Thesis, Univ. Uppsala (1956).

$14^h Zn^{69}$ source
$\beta^-$ **0.92** *2* F-K linear scin

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955); Columbia Tech. Transl. p.294.

$Zn^{69}_{30\ 39}$ $14^h$ $\tau$ **13.9**$^h$ *2* $As^{75}$(170-Mev p) chem

56R45 G.Rudstam, Thesis, Univ. Uppsala (1956).

$\gamma(Zn^{69})$ **0.439** *3* $\alpha_K = 0.040$ *5* scin ce
$K/L = 7.5$ *10* M4

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955); Columbia Tech. Transl. p.294

Ga 31 Relative isotopic abundances ms
No $Ga^{66}$, $Ga^{67}$, $Ga^{68}$, $Ga^{73}$, $Ga^{74}$ ($<0.04\%$)
No $Ga^{70}$ ($<0.07\%$) No $Ga^{72}$ ($<0.2\%$)

56K38 L.Kerwin, D.E.McElcheran, Can. J. Phys. 34, 1497 (1956).

$Ga^{67}_{31\ 36}$ $78^h$ $\tau$ **77.9**$^h$ *3* differential ic

55T27 J.Tobailem, Ann. phys. 10, 783 (1955); Compt. rend. 233, 1360 (1951).

$Ga^{67}_{31\ 36}$ $78^h$ $\tau$ **79.0**$^h$ *3* $As^{75}$(170-Mev p) chem

56R45 G.Rudstam, Thesis, Univ. Uppsala (1956).

$Ga^{69}_{31\ 38}$ Reaction $\gamma$ $Ga^{69}(\alpha,\alpha'\gamma)$ $E_\alpha = 4.8$; scin $\gamma$
**0.322** *3* $\epsilon B(E2) = 0.0079$ *16*
No (0.322$\gamma$)$\gamma$

56F29 L.W.Fagg, E.H.Geer, E.A.Wolicki, Phys. Rev. 104, 1073 (1956); Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956).

$Ga^{71}_{31\ 40}$ Reaction $\gamma$ $Ga^{71}(\alpha,\alpha'\gamma)$ $E_\alpha = 4.4$; scin $\gamma$
**0.513** *5* $\epsilon B(E2) = 0.012$ *2*
No (0.513$\gamma$)$\gamma$

56F29 L.W.Fagg, E.H.Geer, E.A.Wolicki, Phys. Rev. 104, 1073 (1956); Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956).

$Ge^{66}_{32\ 34}$ $\sim 2.5^h$ $\gamma(Ga^{66})$ $Zn^{(64)}$(52-Mev $\alpha$, 2n) chem
10† **0.045** *1* scin
$\sim$2† **0.070** *1* $\sim$5† **0.186** *4*
$\sim$5† **0.114** *2* $\sim$**0.36?**

56R49 R.A.Ricci, R. van Lieshout, Nuovo cim. 4, 1592 (1956).

$Ge^{67}_{32\ 35}$ $20^m$ $\tau$ **18.2**$^m$ *12* $As^{75}$(170-Mev p) chem

56R45 G.Rudstam, Thesis, Univ. Uppsala (1956).

$\tau$ **21**$^m$ *1* $Zn^{(64)}$(52-Mev $\alpha$, n) chem
$\gamma(Ga^{67})$ **0.170** scin
$0.170\gamma/\beta^+ > 0.60$ $\gamma/\gamma^\pm$

56R49 R.A.Ricci, R. van Lieshout, Nuovo cim. 4, 1592 (1956).

$Ge^{70}_{32\ 38}$ Level $Ge^{70}(\alpha,\alpha'\gamma)$ $E_\alpha = 6.5$
**1.02** *1* $\tau = 2.7^{\mu\mu s}$ *4* scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956).

$Ge^{72}_{32\ 40}$ Level $Ge^{72}(\alpha,\alpha'\gamma)$ $E_\alpha = 6.5$
**0.830** *8* $\tau = 4.3^{\mu\mu s}$ *4* scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 99, 617A (1955).

Levels $Ge^{(73)}(\gamma,n)$ $E_\gamma \leq 20$
**(0.835)** $Q = -7.34$ *15* thresh n
**(1.46)** $Q = -7.96$ *15*

56T20 R.Tobin, J.McElhinney, Bull. Am. Phys. Soc. 1, No. 7, 340 P10 (1956).

$Ge^{74}$ 32 42

Level $Ge^{74}(\alpha,\alpha'\gamma)$ $E_\alpha = 6.0$

**0.593** *6* $\tau = 16^{\mu\mu s}$ *2* scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 99, 617A (1955).

$Ge^{76}$ 32 44

Level $Ge^{76}(\alpha,\alpha'\gamma)$ $E_\alpha = 4.0$ to 6.5

**0.566** *6* $\tau = 20^{\mu\mu s}$ *3* scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956).

$As^{75}$ 33 42

Level $As^{75}(\gamma,\gamma)$ $Se^{75}$ vapor

**(0.265)** $\tau \sim 7^{\mu\mu s}$ (half-life)

$\gamma\gamma(\theta)$ isotropic

$\tau$ from $\Gamma$ determined from self-absorption of resonance radiation

56M75 F.R.Metzger, J. Franklin Inst. 262, 229 (1956).

Reaction $\gamma$'s $As^{75}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

| $E_\gamma$ | eB(E2) | |
|---|---|---|
| **0.200** *2* | 0.025 *4* | scin $\gamma$ |
| **0.283** *3* | 0.071 *11* | |
| **0.574** *6* | 0.072 *11* | |
| **0.814** *8* | 0.066 *10* | |

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 100, 961A (1955).

$Se^{74}$ 34 40

Level $Se^{74}(\alpha,\alpha'\gamma)$ $E_\alpha = 7$

**0.635** *6* $\tau = 13^{\mu\mu s}$ scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 100, 961A (1955).

Level $Se^{(74)}(\gamma,\gamma)$ $As^{74}$ gas

**(0.635)** $\tau = 4^{\mu\mu s}$ *2* scin

55M100 F.R.Metzger, J. Franklin Inst. 260, 239 (1955).

$Se^{76}$ 34 42

Level $Se^{76}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

**0.567** *6* $\tau = 12^{\mu\mu s}$ *2* scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 100, 961A (1955).

$Se^{78}$ 34 44

Level $Se^{78}(\alpha,\alpha'\gamma)$ $E_\alpha = 4.5$ to 6.8

**0.615** *6* $\tau = 9.0^{\mu\mu s}$ *14* scin $\gamma$

J = 2 $\alpha,\gamma(\theta)$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 100, 961A (1955).

$Se^{79}$ 34 45 $3.9^m$

$\gamma(Se^{79})$ **0.096** *1* $\alpha_K = 10^*4$ scin ce, pe

K/L = 3.0 *5* E3

*Using $\alpha_K = 7.1$ *15* for 0.103$\gamma$ from $57^m Se^{81}$

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955), Columbia Tech. Transl. p.294.

$Se^{80}$ 34 46

Level $Se^{80}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

**0.654** *7* $\tau = 10.5^{\mu\mu s}$ *15* scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 100, 961A (1955).

$Se^{81}$ 34 47 $57^m$

$\gamma(Se^{81})$ **0.100** $\alpha_K = 8.6^*24$ scin ce, scin pe

K/L = 4.0 *2* E3

*Using $\alpha_{LM} = 12.0$ *5* for 0.088$\gamma$ from $40^s Ag^{109}$

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov., Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955); Columbia Tech. Transl. p. 294.

$Se^{82}$ 34 48

Level $Se^{82}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

**0.880** *9* $\tau = 9.0^{\mu\mu s}$ *14* scin $\gamma$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 100, 961A (1955).

$Br^{80}$ 35 45 $4.5^h$

(ce 0.048 $\gamma$)(ce 0.036 $\gamma$)($\theta$) J = 6 or 5, $2^-$, $1^+$

55S91 B.A.Shakhbazyan, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 308 (1955), Columbia Tech. Transl. p.280.

$Br^{82}$ 35 47 $36^h$

| | | | |
|---|---|---|---|
| $\beta^-$ 100% | **0.46** *1* | | scin, scin $\beta\gamma$ |
| $\gamma(Kr^{82})$ | ~0.25 | | **0.82** scin $\gamma,\gamma\gamma$ |
| | ~0.35 | | **1.03** |
| | **0.56** | | **1.29** |
| | **0.61** | | **1.45** |
| | **0.69** | w | ~1.8 |
| | **0.77** | w | ~2.0 |

(0.56 $\gamma$)(~0.25, ~0.35, 0.61, 0.69, 0.77, 1.29$\gamma$)

(0.77 $\gamma$)(~0.25, ~0.35, 0.61, 0.69, 0.82, 1.29$\gamma$)

(1.03 $\gamma$)(~0.25, 0.56, 0.77, 0.82$\gamma$)

(1.45 $\gamma$)(~0.25, ~0.35, 0.56, 0.61, 0.82$\gamma$)

56D31 V.S.Dubey, C.E.Mandeville, M.A. Rothman, Phys. Rev. 103, 1430 (1956).

$Br^{84}$ 35 49 $32^m$

| | | | |
|---|---|---|---|
| $\tau$ | **31.80**$^m$ | | U(n,f) chem |
| $\beta^-$ | **0.83** | | scin $\beta\gamma$ |
| | **1.39** *10* | | |
| | **1.81** *6* | | |
| | **2.80** *10* | | |
| | **3.83** *7* | | |
| | **4.76** *10* | | scin |
| $\gamma(Kr^{84})$ | **0.29** | **1.48** | scin $\gamma$, |
| | **0.37** | **1.57** | scin $\gamma\gamma$ |

Continued

$Br^{84}$ 35 49 $32^{s}$

Continued

| | |
|---|---|
| 0.43 | 1.70 |
| 0.47 | 1.90 |
| 0.52 | 2.05 |
| 0.61 | 2.17 |
| 0.73 | 2.47 |
| 0.81 | 2.84 |
| 0.879 *7* | 3.03 |
| 1.01 | 3.29 |
| 1.21 | 3.93 *4* |

(1.39 $\beta$)(2.47$\gamma$) (3.83 $\beta$)(0.879$\gamma$)
(2.80 $\beta$)(1.90$\gamma$) No (4.76$\beta$)$\gamma$
(0.879$\gamma$)(0.29, 0.37, 0.43, 0.52, 0.61, 0.73, 0.81, 0.88?, 1.01, 1.21, 1.48, 1.57, 1.70, 1.90, 2.47, 2.84, 3.03, 3.29$\gamma$)
(1.90$\gamma$)(0.81, 0.88?, 1.01, 1.21, 1.57, 1.90, 2.05$\gamma$)

57J10 N.R.Johnson, G.D.O'Kelley, Bull. Am. Phys. Soc. 2, No. 1, 24 G4 (1957).

$Br^{88}$ 35 53 $15.5^{s}$

$\tau$ **$15.5^{s}$** *3* U(n,f) chem
Identified as a delayed neutron emitter

57P11 G.J.Perlow, A.F.Stehney, Bull. Am. Phys. Soc. 2, No. 1, 16 E6 (1957); verbal report.

$Kr^{78}$ 36 42

Reaction $\gamma$ $Kr^{78}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 6.1, 6.6
**0.450** scin

57P26 G.F.Pieper, N.P.Heydenburg, C.E. Anderson, Bull. Am. Phys. Soc. 2, No. 1, 69 XA3 (1957).

$Kr^{79}$ 36 43

Levels $Kr^{78}(d,p)$ $E_d$ = 3.8
g.s. Q = 5.98 *5* ppl 90°
**0.46** *7*

56B110 N.C.Blais, W.W.Watson, Phys. Rev. 104, 202 (1956); Bull. Am. Phys. Soc. 1, No. 6, 281 B9 (1956).

$Kr^{80}$ 36 44

Reaction $\gamma$ $Kr^{80}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 6.1, 6.6
**0.620** scin

57P26 G.F.Pieper, N.P.Heydenburg, C.E. Anderson, Bull. Am. Phys. Soc. 2, No. 1, 69 XA3 (1957).

$Kr^{81}$ 36 45

Levels $Kr^{80}(d,p)$ $E_d$ = 3.8 ppl 90°

| Assignment | Q |
|---|---|
| $Kr^{81}$? | 5.63* *10* |
| $Kr^{81}$, $Kr^{83}$? | 5.4* |
| $Kr^{81}$ | 5.04 *6* |
| $Kr^{81}$ | 4.57 *6* |

*From weak p groups near strong $Kr^{79}$ group

56B110 N.C.Blais, W.W.Watson, Phys. Rev. 104, 202 (1956); Bull. Am. Phys. Soc. 1, No. 6, 281 B9 (1956).

$Kr^{82}$ 36 46

Reaction $\gamma$ $Kr^{82}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 6.1, 6.6
**0.780** scin

57P26 G.F.Pieper, N.P.Heydenburg, C.E. Anderson, Bull. Am. Phys. Soc. 2, No. 1, 69 XA3 (1957).

$Kr^{83}$ 36 47

$Kr^{83}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 6.1, 6.6
No $\gamma$ observed (0.457$\gamma$ assigned to $Kr^{78}$) scin

57P26 G.F.Pieper, N.P.Heydenburg, C.E. Anderson, Bull. Am. Phys. Soc. 2, No. 1, 69 XA3 (1957).

$Kr^{84}$ 36 48

Reaction $\gamma$ $Kr^{84}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 6.1, 6.6
**0.880** scin

57P26 G.F.Pieper, N.P.Heydenburg, C.E. Anderson, Bull. Am. Phys. Soc. 2, No. 1, 69 XA3 (1957).

$Rb^{85}$ 37 48

Reaction $\gamma$ $Rb^{85}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 4.4; scin $\gamma$
**0.148** *1* $\epsilon B(E2)$ = 0.0032 *6*

56F29 L.W.Fagg, E.H.Geer, E.A.Wolicki, Phys. Rev. 104, 1073 (1956); Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956).

$Rb^{86}$ 37 49 $19^{d}$ g.s.

$\beta\gamma$ delay < $100^{\mu\mu s}$ scin

55B148 E.E.Berlovich, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 343 (1955), Columbia Tech. Transl. p.305.

$Rb^{87}$ 37 50

Reaction $\gamma$ $Rb^{87}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 4.4; scin $\gamma$
**0.407** *4* $\epsilon B(E2)$ = 0.0058 *12*

56F29 L.W.Fagg, E.H.Geer, E.A.Wolicki, Phys. Rev. 104, 1073 (1956); Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956).

Sr 38

No ~ $10^{d}$ Sr U(n,f) chem

56H77 G.Herrmann, F.Strassmann, Z.Naturf. 11a, 946 (1956).

$Sr^{85}$ 38 47 $65^{d}$ g.s.

$\tau$ **$63.0^{d}$** *7* U(n,f) chem

56H77 G.Herrmann, F.Strassmann, Z. Naturf. 11a, 946 (1956).

$Sr^{87}$ 38 49 $2.8^{h}$

$\tau$ **$2.90^{h}$** *8* U(n,f) chem

56H77 G.Herrmann, F.Strassmann, Z.Naturf. 11a, 946 (1956).

$Sr^{89}$ 38 51 $51^{d}$

$\gamma(Y^{89})$ U(n,f) chem; scin
~0.01% **0.93** *5* from $13^{s}$ level in $Y^{89}$

56H77 G.Herrmann, F.Strassmann, Z. Naturf. 11a, 946 (1956).

$Sr^{90}$ 38 52 $28^{y}$

$\beta^-$ **0.541** *8* $\Delta J$ = 2, yes shape sl

56N21 T.D.Nainan, H.G.Deware, A.Mukerji, Proc. Indian Acad. Sci. 44A, 111 (1956).

$Sr^{92}$ 38 54 $2.6^h$

| | | | |
|---|---|---|---|
| $\tau$ | | $2.60^h$ 4 | U(n,f) chem |
| $\beta^-$ | 90% | 0.55 5 | a |
| | 10% | 1.5 1 | a |
| $\gamma(Y^{92})$ | | ~1.5 | a |

56H77 G.Herrmann, F.Strassmann, Z. Naturf. 11a, 946 (1956).

$Y^{88}$ 39 49 $105^d$ g.s.

| | | |
|---|---|---|
| $\gamma(Sr^{88})$ | | $Sr^{(88)}$(12-Mev p,n) |
| 92† | (0.90) | scin |
| 100† | 1.85 | |
| 0.5† | 2.76 | |

56T24 F.M.Tomnovec, Bull. Am. Phys. Soc. 1, No. 8, 391 M12 (1956).

$Y^{90}$ 39 51 $64^h$

| | | |
|---|---|---|
| $\tau$ | $64.8^h$ 2 | U(n,f) chem |

56H77 G.Herrmann, F.Strassmann, Z. Naturf. 11a, 946 (1956).

| | | |
|---|---|---|
| $\beta^-$ | 2.28 3 | $\Delta J = 2$, yes shape sl |

56N21 T.D.Nainan, H.G.Deware, A.Mukerji, Proc. Indian Acad. Sci. 44A, 111 (1956).

$Y^{91}$ 39 52 $58^d$ g.s.

| | | | |
|---|---|---|---|
| $\tau$ | | $58.3^d$ 8 | U(n,f) chem |
| $\gamma(Zr^{91})$ | | | |
| | 0.4% | 1.2 1 | scin |
| No 0.2$\gamma$ ( <0.1%) | | | |

56H77 G.Herrmann, F.Strassmann, Z. Naturf. 11a, 946 (1956).

$Zr^{90}$ 40 50

| | | |
|---|---|---|
| Level | $Zr^{90}(n,n'+e^+e^-)$ | pulsed n's |
| (1.75) | $\tau = 71^{+7}_{-10}$ mμs | scin $\gamma^\pm$ |

57K29 R.M.Kloepper, R.B.Day, D.A.Lind, Bull. Am. Phys. Soc. 2, No. 1, 60 U6 (1957); verbal report.

$Zr^{95}$ 40 55 $65^d$

| | | | |
|---|---|---|---|
| $\beta^-$ | 43% | 0.360 5 | sπ |
| | 55% | 0.396 5 | |
| | 2% | 0.885 10 | |
| $\gamma(Nb^{95})$ | | 0.726 2 | $\alpha_K = 1.3 \times 10^{-3}$ 2 sπ ce |
| | | | K/L = 9 1 M1 |
| | | 0.760 3 | $\alpha_K = 1.80 \times 10^{-3}$ 25 |
| | | | K/L = 6 1 E2 |

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955), Columbia Tech. Transl. p.294.

$Nb^{93}$ 41 52

| | | |
|---|---|---|
| Level | $Nb^{93}(n,n'\gamma)$ | $E_n \leq 1.2$; scin $\gamma$ |
| | 0.764 8 | thresh for 0.736$\gamma$ |
| | 0.977 10 | thresh for 0.957$\gamma$ |

Both 0.736$\gamma$ and 0.957$\gamma$ lead to 0.029 level

57R46 M.A.Rothman, D.M.Van Patter, V.S. Dubey, W.C.Porter, C.E.Mandeville, Bull. Am. Phys. Soc. 2, No. 1, 33 K6 (1957); verbal report.

$Nb^{94}$ 41 53

| | | | |
|---|---|---|---|
| Resonance peaks | $Nb^{93}(n)$ | $E_n$ = 30 to 10,000 ev | |
| | 35.9 ev | $\Gamma_\gamma$ = 229 5 mev | chopper |
| | 42.2 | $\Gamma_\gamma$ = 186 100 mev | |
| | 94.3 | 381 | |
| | 106 | 463 | |
| | 119 | 500 | |
| | 194 | 746 | |
| | 244 | 947 | |
| | 320 | 1018 | |
| | 336 | 1184 | |

56S91 A.Saplakoglu, L.M.Bollinger, R.E.Coté, Bull. Am. Phys. Soc. 1, No. 7 347 X7 (1956); verbal report.

$Nb^{95}$ 41 54 35d g.s.

| | | | |
|---|---|---|---|
| $\beta^-$ | 99% | 0.160 3 | sπ |
| | 1% | 0.93 2 | |
| $\gamma(Mo^{95})$ | | 0.770 2 | $\alpha_K = 1.9 \times 10^{-3}$ 1 sπ ce |
| | | | K/L = 7.4 2 E2 |

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955), Columbia Tech. Transl. p.294.

$Nb^{95}$ 41 54 $90^h$

| | | | |
|---|---|---|---|
| $\tau$ | | $90^h$ 2 | |
| $\gamma(Nb^{95})$ | | (0.236) | K/L = 4.5 1 sπ ce |

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955), Columbia Tech. Transl. p.294.

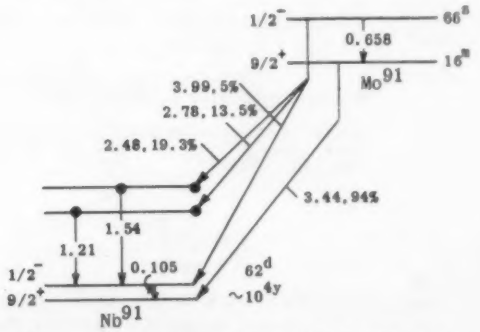
$Mo^{91}$ 42 49 $16^m$ g.s.

| | | |
|---|---|---|
| | | $Mo^{(92)}$( ≤22-Mev $\gamma$,n) |
| $\beta^+$ | 3.44 3 | sd |
| No $\gamma$ | | scin |

56S96 F.B.Smith, N.B.Gove, R.W.Henry, R.A. Becker, Phys. Rev. 104, 706 (1956); 100, 1236A (1955).

$Mo^{91}$ 42 49 $66^s$

| | | | |
|---|---|---|---|
| | | | $Mo^{(92)}$( ≤22-Mev $\gamma$,n) |
| $\beta^+$ | 2.48 10 | | scin $\beta\gamma$ |
| | 2.78 10 | | scin $\beta\gamma$ |
| | 3.99 5 | | scin |
| $\gamma(Mo^{91})$ | 0.658 3 | $\alpha = 0.055$ 15 | scin |
| $\gamma(Nb^{91})$ 68† | 1.21 3 | | |
| 100† | 1.54 2 | | |
| $\gamma^\pm/(0.658\gamma) = 1.4$ 2 | | | |
| (K x ray)/(0.658$\gamma$) = 0.15 5 | | | |
| (3.99$\beta$)/(2.48$\beta$ + 2.78$\beta$) = 0.15 | | | scin |
| (2.78$\beta$)(1.21$\gamma$) | (2.48$\beta$)(1.54$\gamma$) | | |
| No $\gamma^\pm$(0.658$\gamma$) | No (1.21$\gamma$)(1.54$\gamma$) | | |




56S96 F.B.Smith, N.B.Gove, R.W.Henry, R.A. Becker, Phys. Rev. 104, 706 (1956); 100, 1236A (1955).

$Mo^{101}_{42\ 59}$ $15^m$

| | | | |
|---|---|---|---|
| $\tau$ | $14.61^m$ *7* | | |
| $\beta^-$ | 2.23 *4* | | |
| $\gamma(Tc^{101})$ | 0.0833 | 0.896 | scin |
| | 0.193 | 1.02 | |
| | 0.403 | 1.19 | |
| | 0.515 | 1.54 | |
| | 0.585 | 1.68 | |
| | 0.707 | 2.08 | |

57001 G.D.O'Kelley, Q.V.Larson, G.E.Boyd, Bull. Am. Phys. Soc. 2, No. 1, 24 G5 (1957).

| | | | |
|---|---|---|---|
| $\beta^-$ | 0.6 | 1.2 | s,scin |
| | 0.7 | 1.6 | |
| | 0.8 | 2.2 | |
| $\gamma(Tc^{101})$ | 0.080 | | scin |
| | 0.191 | $\alpha_K = 0.30$ *6* | |
| | 0.193* | 0.95* | |
| | 0.300* | 1.024 | |
| | 0.40* | 1.14* | |
| | 0.51* | 1.18 | |
| | 0.510 | 1.28* | |
| | 0.590 | 1.38* | |
| | 0.70* | 1.46* | |
| | 0.704 | 1.56 | |
| | 0.84* | 1.66* | |
| | 0.890 | 2.08 | |

$\beta(0.191\gamma)$ delay = $0.91^{ms}$
(0.59 $\gamma$)(0.6, 1.2, 2.2$\beta$) (2.08 $\gamma$)(0.7$\beta$)
(0.51 $\gamma$)(0.8, 1.6, 2.2$\beta$) (0.70 $\gamma$)(0.6, 1.6$\beta$)
(0.70 $\gamma$)(1.28, 1.46$\gamma$) (0.510 $\gamma$)(0.51, 1.56$\gamma$)
(0.590 $\gamma$)(0.300, 0.704, 1.18, 1.38$\gamma$)
(0.890 $\gamma$)(0.704, 1.18$\gamma$) (0.95 $\gamma$)(1.024$\gamma$)
(0.84 $\gamma$)(1.14$\gamma$) (0.193 $\gamma$)(0.51, 1.28$\gamma$)
(1.38 $\gamma$)(0.40$\gamma$) (0.080 $\gamma$)(1.66$\gamma$)
*from scin $\gamma\gamma$

56M72 D.W.Martin, S.B.Burson, J.M.Cork, Bull. Am. Phys. Soc. 1, No. 7, 329 J5 (1956); verbal report.

$Tc^{98}_{43\ 55}$ $1.5 \times 10^{6y}$

Mo(22-Mev p) chem

$\tau$ $1.5 \times 10^{6y}$ *7* specific activity

Measured (0.65 $\gamma$)(0.75$\gamma$) counting rate in sample containing 17.3% $Tc^{98}$

56010 G.D.O'Kelley, Q.V.Larson, Southwide Chem. Conf., Dec. 1956.

$Tc^{99}_{43\ 56}$ $6.0^h$

carrier free source from $Mo^{99}$

$\gamma(Tc^{99})$ (99%) (0.140)
(1%) (0.142) ] K/LM = 5.87 *12* sl ce
$e_{KLL}:e_{KLX}:e_{KXY}$ = 1:0.48 *6*:0.05 *1* sl

Measurements give $\omega_K(Tc) = 0.70$ *3*

56L40 J.Laberrigue-Frolow, P.Radvanyi, J. phys. radium. 17, 944 (1956); Compt. rend. 242, 901 (1956).

$Tc^{101}_{43\ 58}$ $14^m$

| | | | | | |
|---|---|---|---|---|---|
| $\tau$ | $14.0^m$ *1* | | | | |
| $\beta^-$ | 1.07 *3* | | | 1.32 *3* | |
| $\gamma(Ru^{101})$ | | | 18†* | 0.385 *8* | scin |
| | 7.6†* | 0.127 *4* | 4† | 0.410 *10* | |

Continued

$Tc^{101}_{43\ 58}$ $14^m$

Continued

| | | | |
|---|---|---|---|
| 26† | 0.130 *3* | 83† | 0.545 *5* |
| 3.9†* | 0.183 *4* | 10† | 0.635 *10* |
| 23† | 0.186 *4* | 12† | 0.720 *8* |
| 8† | 0.235 *5* | 3.6† | 0.846 *9* |
| 1000† | 0.307 *4* | 2.5† | 0.939 *10* |

(1.07$\beta$)(0.545$\gamma$) (1.32$\beta$)(0.307$\gamma$)
(0.127 $\gamma$)(0.720$\gamma$) (0.186 $\gamma$)(0.130$\gamma$)
(0.307 $\gamma$)(0.127, 0.183, 0.235$\gamma$)
(0.545 $\gamma$)(0.127, 0.183, 0.385$\gamma$) *From scin $\gamma\gamma$

57001 G.D.O'Kelley, Q.V.Larson, G.E.Boyd, Bull. Am. Phys. Soc. 2, No. 1, 24 G5 (1957); verbal report.

$Tc^{102}_{43\ 59}$ ? $5^s$

| | | |
|---|---|---|
| $\tau$ | $5^s$ *1* | d $12^m$Mo chem |
| $\beta^-$ | 4.2 *3* | a |

55F51 J.Flegenheimer, W.Seelman-Eggebert, Proc. Intern. Conf. Peaceful Uses Atomic Energy, Geneva 7, 152 (1955); Z. Naturf. 9a, 806 (1954).

$Ru^{103}_{44\ 59}$ $40^d$

| | | | |
|---|---|---|---|
| $\beta^-$ | | ~0.12 | sm |
| | 75 20% | 0.23 | |
| | 5 1% | 0.70 | |
| $\gamma(Rh^{103})$ | | 0.040 | K/L = 0.18 *3* sm ce |
| | | | L/M = 7 *1* E3 |
| | | 0.498 | $\alpha_K = 5.4 \times 10^{-3}$ *1* |
| | | | K/L = 6.0 *15* |
| | | 0.610 | |

(ce 0.040$\gamma$)/$\beta$~1

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955), Columbia Tech. Transl. p.294.

$Ru^{106}_{44\ 62}$ $1.0^y$

$\tau$ $366.6^d$ *9* U(n,f) chem

56S87 R.P.Schuman, M.E.Jones, A.C.Mewherter, J. Inorg. Nucl. Chem. 3, 160 (1956).

$Rh^{103}_{45\ 58}$

| Level | $Rh^{103}(n,n'\gamma)$ $E_n \leq 0.90$; scin $\gamma$ |
|---|---|
| 0.300 | thresh for 0.300$\gamma$ |

57R46 M.A.Rothman, D.M.Van Patter, V.S.Dubey, W.C.Porter, C.E.Mandeville, Bull. Am. Phys. Soc. 2, No. 1, 33 K6 (1957); verbal report.

$Ag^{105}_{47\ 58}$

$39^d$ ground state $Rh^{103}$(40-Mev $\alpha$,2n)

J 1/2 M

$\tau$ $39^d$

56S100 H.B.Silsbee, W.A.Nierenberg, H.A. Shugart, P.O.Strom, Bull. Am. Phys. Soc. 1, No. 8, 389 M2 (1956).

$_{47}Ag^{107}_{60}$ Reaction $\gamma$ $Ag^{107}(p,p'\gamma)$ $E_p = 1.75$

0.323 *3* $\epsilon B(E2) = 0.002$ *1* sd $ce_K$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$'s $Ag^{107}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0, 6.0$

0.318 *3* $\epsilon B(E2) = 0.15$ scin $\gamma$

0.413 *4* $= 0.21$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 95, 861 (1954).

$_{47}Ag^{109}_{62}$ Reaction $\gamma$ $Ag^{109}(p,p'\gamma)$ $E_p = 1.75$

0.308 *3* $\epsilon B(E2) \sim 0.0026$ sd $ce_K$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$'s $Ag^{109}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.0, 6.0$

0.305 *3* $\epsilon B(E2) = 0.17$ scin $\gamma$

0.400 *4* $= 0.24$

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 95, 861 (1954).

$_{47}Ag^{111}_{64}$ $7.5^d$ ground state $Pd^{(110)}(n,\gamma\beta)$ chem

J 1/2 M

$\mu$ −0.1450 *15*

Used $K^{39}$ and $Ag^{109}$ data

56W27 G.K.Woodgate, R.W.Hellworth, Proc. Phys. Soc. 69A, 581 (1956); Nature 176, 395 (1955).

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Cd Relative isotopic abundances ms

$_{48}$ No $Cd^{103}$, $Cd^{104}$, $Cd^{105}$, $Cd^{107}$, $Cd^{109}$, $Cd^{115}$, $Cd^{117}$ ($< 0.01\%$)

56K32 L.Kerwin, Can. J. Phys. 34, 1080 (1956).

$_{48}Cd^{114}_{66}$ Capture $\gamma$'s $Cd^{(113)}$(th n,$\gamma$)

| | | | | |
|---|---|---|---|---|
| 85† | 0.559 *2* | | | sl ce,Cp,pe |
| ~7† | 0.576 *4* | | | |
| 23† | 0.654 *2* | $\alpha = 0.0025^*$ *5* | | |
| 6.5† | 0.728 *3* | $\alpha = 0.0025^*$ *10* | | |
| 2.5† | 0.752 *5* | | | |
| 9.3† | 0.808 *3* | $\alpha = 0.0021^*$ *10* | | |
| 6.5† | 1.210 *5* | | | |
| 5.7† | 1.298 *5* | 6† | 1.660 *10* | |
| 11.6† | 1.370 *5* | ~3† | 1.845?*15* | |
| 5.5† | 1.403 *5* | ~2.5† | ~1.96? | |
| 4.4† | 1.498 *5* | ~3† | 2.455?*15* | |

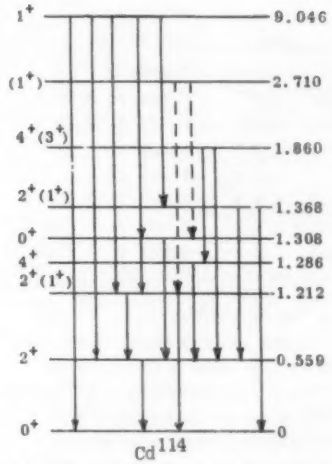
Also observed ce assigned to $0^+ - 0^+$ transition of energy 1.305 *8*

†Photons/100 Cd captures

*Used $\alpha(0.559\gamma) = 0.0043$

Continued

$_{48}Cd^{114}_{66}$ Continued




5 highest energy $\gamma$'s taken from others

56W92 H.T.Motz, Phys. Rev. 104, 1353 (1956) 86, 604A (1952); 90, 355A (1953); 99, 656A (1955).

$_{49}In^{108}_{59}$ $40^m$ g.s.

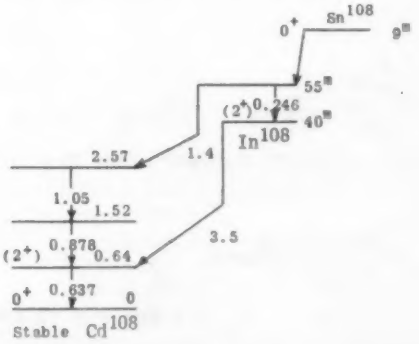
| | | |
|---|---|---|
| $\tau$ | $40^m$ 2 | $Cd^{106}$(40-Mev $\alpha$,2n$\epsilon$), $Ag^{107}$(40-Mev $\alpha$,3n) chem |
| $\beta^+$ | 3.5 *1* | sl |
| $\gamma(Cd^{108})$ | 0.637 | sl ce |

56M94 W.Mead, UCRL-3488 (1956).

$_{49}In^{108}_{59}$ $55^m$

| | | | |
|---|---|---|---|
| $\tau$ | $55^m$ | $Ag^{107}$(40-Mev $\alpha$,3n) chem | |
| $\beta^+$ | 1.4 *1* | | sl |
| $\gamma(In^{108}?)$ | | | |
| 100* | 0.246 | K/L = 3.7 *5* | sl ce |
| $\gamma(Cd^{108})$ | | | |
| 22* | 0.330 | K/L = 4 | |
| 32* | 0.637 | | |
| 10* | 0.878 | | |
| 3* | 1.05 | | |

*Relative ce intensities




56M94 W.Mead, UCRL-3488 (1956); Phys. Rev. 100, 1794A (1955).

$In^{109}_{49\ 60}$ $Ag^{107}$(26-Mev α, 2n) chem
$4.3^h$ g.s.

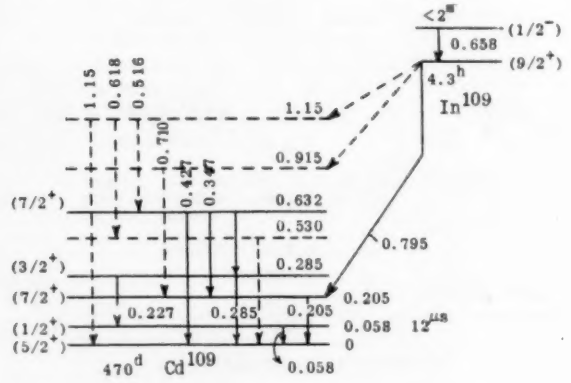
| | | | | | | |
|---|---|---|---|---|---|---|
| $\beta^+$ | | ~0.3? | | | | sl |
| | 1.8 2%[§] | 0.795 *10* | | | | |
| $\gamma(Cd^{109})$ | | | α | K/LM | sl ce, | |
| <1† | 49 *3*° | 0.0580 *5* | >5 | 0.85 *8* | pe | |
| 100† | 100 ° | 0.205 *1* | 0.07 *1* | 7.6 *4* | | |
| ~4† | 2.0 *7*° | 0.227 *1* | 0.04 *2* | | | |
| | 1.4 *3*° | 0.285 *2* | | 5 | | |
| | 0.6 *2*° | 0.325 *3* | | | | |
| 4† | 1.4 *2*° | 0.347 *3* | 0.020 *8* | 5.1 *5* | | |
| 9† | 1.7 *2*° | 0.427 *3* | 0.014 *5* | 8 *1* | | |
| ~40† | 1.8 *4*° | 0.632 *5* | 0.0032 *15* | | | |

Also weak 0.516, 0.530, 0.618, 0.710, 0.805, 1.15γ

(0.795β)(0.205γ) scin
(>0.205 γ)(ce 0.058γ) delay = $12^{\mu s}$ *3*
No (0.205 γ)(ce 0.058γ) delay
[§]From $\beta^+$/(ce 0.088γ of $Cd^{109}$) using α = 23
°Relative ce intensity
†Relative photon intensity
α's based on α = 0.12 for $In^{111}$ 0.172γ

56P39 M.D.Petroff, Bull. Am. Phys. Soc. 1, No. 8, 389 M3 (1956); UCRL 3538 (1956).

$In^{109}_{49\ 60}$ τ <$2^m$ d $18^m Sn^{109}$ chem
<$2^m$ γ($In^{109}$) 0.658 α = 0.07 *2* M4 sl ce




56P39 M.D.Petroff, Bull. Am. Phys. Soc. 1, No. 8, 389 M3 (1956); UCRL-3538 (1956).

$In^{113}_{49\ 64}$ $118^d$Sn source
$1.7^h$ γ($In^{113}$) (0.392) α = 0.52 *5*

56A28 P.Avignon, Ann. Phys. 1, 10 (1956).

$In^{113}_{49\ 64}$ $1.7^h$Level
J 1/2 M
μ +0.2098 *4* or −0.2105 *4*

56C52 W.J.Childs, L.S.Goodman, Bull. Am. Phys. Soc. 1, No. 7, 342 R1 (1956); priv. comm.

$In^{115}_{49\ 66}$? Reaction γ $In^{(115)}$(p,?γ) $E_p$ = 2.2 to 3.5
0.512 *12* scin
Excitation function indicates reaction proceeds via compound nucleus

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, H.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

$In^{115}_{49\ 66}$ $Cd^{(114)}$(n,γβ) chem
$4.5^h$ γ($In^{115}$) (0.335) K/LM = 3.75 *15* sl ce
$e_{KLL}:e_{KLX}:e_{KXY}$ sl
= 1:0.42 *10*:0.05 *2*
Measurements give $\omega_K$(In) = 0.87 *3*

56L40 J.Laberrigue-Frolow, P.Radvanyi, J. phys. radium 17, 944 (1956); Compt. rend. 242, 901 (1956).

Sn? τ $19^m$ *1* Cd(15-Mev α) chem
50 γ 0.078 sl ce
Not identical with $18^m Sn^{109}$ activity

56P39 M.D.Petroff, Bull. Am. Phys. Soc. 1, No. 8, 389 M3 (1956); UCRL-3538 (1956); Phys. Rev. 98, 279A (1955).

$Sn^{108}_{50\ 58}$ τ $9^m$ $Cd^{106}$(28-Mev α, 2n) chem
$9^m$ p $40^m In^{108}$

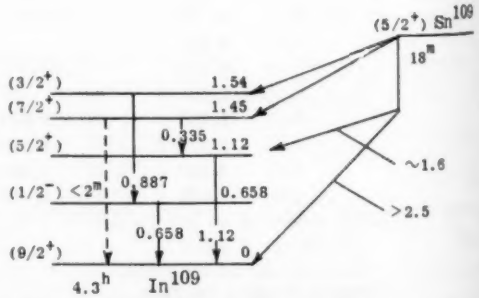
56M94 W.Mead, UCRL-3488 (1956).

$Sn^{109}_{50\ 59}$ τ $18.1^m$ *3* $Cd^{106}$(15-Mev α, n) chem
$18^m$ β⁺ ~1.6 sl
>2.5
γ($In^{109}$) sl ce

| | | | |
|---|---|---|---|
| 98° | 0.335 | | |
| 14° | 0.521 | 12° | 0.887 |
| 1000° | 0.658 | 27° | 1.12 |

ε/β⁺ ~ 4 °Relative ce intensities
No 0.078γ
p $4.3^h In^{109}$ from growth of 0.205γ sl ce

56P39 M.D.Petroff, Bull. Am. Phys. Soc. 1, No. 8, 389 M3 (1956); UCRL-3538 (1956); Phys. Rev. 98, 279A (1955).




56P39 M.D.Petroff, Bull. Am. Phys. Soc. 1, No. 8, 389 M3 (1956); UCRL-3538 (1956).

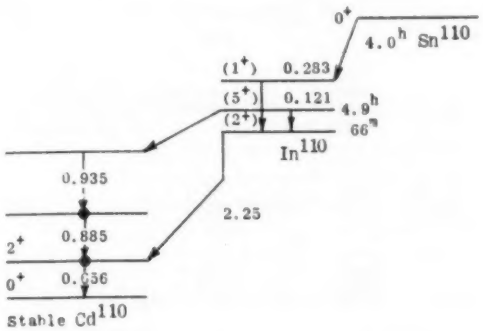
$Sn^{110}$ 50 60 $4.0^h$

$Cd^{108}$(30-Mev α,2n) chem
not by $Cd^{106}$(30-Mev α) chem

$\tau$ **$4.0^h$** 2

$\gamma(In^{110})$ **0.283** α~0.06 sl ce,pe
K/LM = 8 *1*

p $66^m In^{110}$ from growth and decay of 2.2$\beta^+$,0.66$\gamma$
Not p $4.9^h In^{110}$ (no 0.121, 0.884, 0.935$\gamma$)




56M94 W.Mead, UCRL-3488 (1956); Phys. Rev. 100, 1794A (1955).

$Sn^{115}$ 50 65

$Sn^{115}(\alpha,\alpha'\gamma)$ $E_\alpha = 4$
No $\gamma$ observed scin

56F29 L.W.Fagg, E.H.Geer, E.A.Wolicki, Phys. Rev. 104, 1073 (1956); Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956).

$Sn^{117}$ 50 67

$Sn^{117}(\alpha,\alpha'\gamma)$ $E_\alpha = 4$
No $\gamma$ observed scin

56F29 L.W.Fagg, E.H.Geer, E.A.Wolicki, Phys. Rev. 104, 1073 (1956); Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956).

$Sn^{119}$ 50 69

$Sn^{119}(\alpha,\alpha'\gamma)$ $E_\alpha = 4$
No $\gamma$ observed scin

56F29 L.W.Fagg, E.H.Geer, E.A.Wolicki, Phys. Rev. 104, 1073 (1956); Bull. Am. Phys. Soc. 1, No. 4, 165 C4 (1956).

$Sn^{125}$ 50 75 $9.9^d$

$Sn^{124}$(pile n,$\gamma$) chem

$\beta^-$ ~2.4 scin

$\gamma(Sb^{125})$ **0.23** scin $\gamma\gamma$

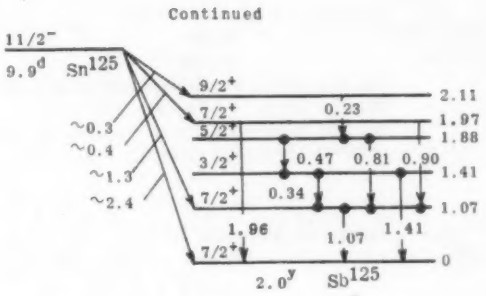
| | | | |
|---|---|---|---|
| 14.5† | **0.34** | | scin $\gamma,\gamma\gamma$ |
| 26.5† | **0.47** | 166† | **1.07** |
| 83† | **0.81** | 10† | **1.41** |
| 50† | **0.90** | 40† | **1.96** |

(0.23$\gamma$X0.47, 0.81, 1.07, 1.41$\gamma$)
(0.47$\gamma\gamma$X0.34, 1.07, 1.41$\gamma$)
(1.07$\gamma\gamma$X0.34, 0.81, 0.90$\gamma$)

56D31 V.S.Dubey, C.E.Mandeville, M.A. Rothman, Phys. Rev. 103, 1430 (1956).

Continued

$Sn^{125}$ 50 75 $9.9^d$ — Continued




56D31 V.S.Dubey, C.E.Mandeville, M.A. Rothman, Phys. Rev. 103, 1430 (1956).

$Sb^{122}$ 51 71 $2.75^d$ g.s.

$\beta^+$ **0.565** 25
$\beta^+/\beta^-$= **$6.46\times10^{-5}$** *40*
$\epsilon_K/\beta^+$ = 300 *50* if $\epsilon$(g.s.)/decay = 0.021 *3*

57W31 M.Wolfsberg, J.Welker, M.L.Perlman, Bull. Am. Phys. Soc. 2, No. 1, 24 G6 (1957); verbal report.

$Sb^{124}$ 51 73 $54^d$ g.s.

| $\gamma(Te^{124})$ | | | |
|---|---|---|---|
| | **0.602** | **0.722** | s ce |
| | **0.645** | **0.789** | |
| | **0.708** | **1.690** | |
| | **0.713** | **2.090** | |

56T25 E.P.Tomlinson, Bull. Am. Phys. Soc. 1, No. 7, 329 J6 (1956).

$(E_\beta = 1.8\ 2)(0.6\gamma)(\theta)$ sl $\beta$, scin $\gamma$
$\eta(\pi) = -0.438\ 27$ 90°, 120°, 150°, 180°

55G67 A.P.Grinberg, I.Kh.Lemberg, Izvest. Nauk Ser. Fiz. SSSR 19, 300 (1955), Columbia Tech. Transl. p.272.

$Te^{126}$ 52 74

Reaction $\gamma$'s $Te^{126}(n,n'\gamma)$ $E_n = 4.4$ scin

| | |
|---|---|
| 60† | **0.68** 2 |
| 20† | **1.38** 4 |

No 0.74$\gamma$ (<3†)
†Photons/100 0.83$\gamma$'s from $Te^{130}(n,n'\gamma)$

56S112, R.M.Sinclair, Phys. Rev. 102, 461 (1956); Bull. Am. Phys. Soc. 1, No. 1, 42 K3 (1956).

$I^{127}$ 53 74

Reaction $\gamma$'s $I^{127}(\alpha,\alpha'\gamma)$

| | |
|---|---|
| | **0.060** 2 |
| | **0.201** 4 |

$I^{127}(p,p'\gamma)$ $E_p = 3.2$; scin $\gamma$

| | | |
|---|---|---|
| 800† | 0.208 *7* | $\epsilon$B(E2) = 0.039 *5* |
| 155† | 0.392 *8* | |
| 45† | 0.438 *10* | $\epsilon$B(E2) = 0.006 *1* |
| 245† | 0.631 *10* | = 0.116 *14* |
| 76† | 0.751 *25* | = 0.074 *9* |
| 9† | 0.941* *50* | |

*Yield as f($E_p$) incompatible with E2 excitation

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

$I^{127}_{53\ 74}$ Reaction $\gamma$'s $I^{127}(n,n'\gamma)$ scin

**0.065**
**0.210**

No 0.140$\gamma$ ($\leq$ a few percent of 0.210$\gamma$)

56H76 H.Heymann, G.Lindström, H.Neuert, Z. Naturf. 11a, 919 (1956).

Xe 54 Reaction $\gamma$'s $Xe(\alpha,\alpha'\gamma)$ $E_\alpha = 6.5$ scin

| $E_\gamma$ | Assigned to A |
|---|---|
| **0.286** *3* | 129, 131 |
| **0.364** *4* | 129, 131 |
| **0.530** *5* | 130 |
| **0.670** *7* | 132 |
| **0.870** *9* | 134 |

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956).

$Xe^{130}_{54\ 76}$ Level $Xe^{(130)}(\alpha,\alpha'\gamma)$ $E_\alpha = 6.5$ scin $\gamma$

**0.530** *5*

56H75 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 967 (1956); Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956).

$Xe^{132}_{54\ 78}$ Level $Xe^{(132)}(\alpha,\alpha'\gamma)$ $E_\alpha = 6.5$ scin $\gamma$

**0.670** *7*

56H75 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 967 (1956); Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956).

$Xe^{134}_{54\ 80}$ Level $Xe^{(134)}(\alpha,\alpha'\gamma)$ $E_\alpha = 6.5$ scin $\gamma$

**0.870** *9*

56H75 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 967 (1956); Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956).

$Cs^{127}_{55\ 72}$ $6.3^h$ ground state $I^{127}(\alpha,4n)$

J **1/2** M

56N16 W.A.Nierenberg, H.A.Shugart, H.B. Silsbee, R.J.Sunderland, Phys. Rev. 104, 1380 (1956).

$Cs^{129}_{55\ 74}$ $31^h$ ground state $Xe^{(129)}(p,n)$

J **1/2** M

56N14 W.A.Nierenberg, J.C.Hubbs, H.A. Shugart, H.B.Silsbee, P.O.Strom, Bull. Am. Phys. Soc. 1, No. 7, 343 R3 (1956).

56N16 W.A.Nierenberg, H.A.Shugart, H.B. Silsbee, R.J.Sunderland, Phys. Rev. 104, 1380 (1956).

$Cs^{130}_{55\ 75}$ $30^m$ ground state $I^{127}(\alpha,n)$

J **1** M

56N16 W.A.Nierenberg, H.A.Shugart, H.B. Silsbee, R.J.Sunderland, Phys. Rev. 104, 1380 (1956).

$Cs^{131}_{55\ 76}$ $10^d$ d 11.5$^d$Ba chem

$E_{dis}$ **0.355** *10* scin $\gamma$-continuum

Shape of continuous $\gamma$ spectrum agrees with predictions of Glauber and Martin*

56H66 D.D.Hoppes, R.W.Hayward, Phys. Rev. 104, 368 (1956); *R.J.Glauber, P.C.Martin, Phys. Rev. 104, 158 (1956).

$Cs^{131}_{55\ 76}$ $10^d$ ground state $Xe^{(131)}(p,n)$

J **5/2** M

56N14 W.A.Nierenberg, J.C.Hubbs, H.A. Shugart, H.B.Silsbee, P.O.Strom, Bull. Am. Phys. Soc. 1, No. 7, 343 R3 (1956).

$Cs^{132}_{55\ 77}$ $6.2^d$ ground state $Xe^{(132)}(p,n)$

J **2** M

56N14 W.A.Nierenberg, J.C.Hubbs, H.A. Shugart, H.B.Silsbee, P.O.Strom, Bull. Am. Phys. Soc. 1, No. 7, 343 R3 (1956).

$Cs^{133}_{55\ 78}$ Ground state

q **−0.0033** *39* M

56B119 P.Buck, I.I.Rabi, B.Senitzky, Phys. Rev. 104, 553 (1956).

Reaction $\gamma$'s $Cs^{133}(\alpha,\alpha'\gamma)$ $E_\alpha = 3$ scin

**0.081** *1*
**0.163** *2*

56T26 G.M.Temmer, N.P.Heydenburg, Phys. Rev. 104, 967 (1956); 93, 351 (1957).

$Cs^{134}_{55\ 79}$ $2.2^y$ g.s. $\gamma(Ba^{134})$ **0.460** *20* scin $\gamma\gamma$

**0.555** *15*
**0.604** *10*
**0.794** *15*
**1.349** scin

(0.604 $\gamma$)(0.460, 0.555, 0.794$\gamma$, 1.349$\gamma$)
(0.794 $\gamma$)(0.555) No (0.794 $\gamma$)(0.460$\gamma$)
No (1.349 $\gamma$)(0.794$\gamma$)

56C71 A.Chandra, Proc. Indian Acad. Sci. 44A, 194 (1956).

$Cs^{137}_{55\ 82}$ $27^y$ $\beta^-$ **0.540** *10* sm

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955), Columbia Tech. Transl. p.294.

$Cs^{138}_{55\ 83}$ $32^m$ $\tau$ **32.1**$^m$ *2* d 17$^m$Xe chem

$\gamma(Ba^{138})$ **0.1134?** scin, sm ce

| | | | | |
|---|---|---|---|---|
| 2% | **0.1389** | $K/L_1 \geq 6$ $L_1:L_2:L_3 = 4: \leq 1: \leq 1$ | | |
| 0.8% | **0.1931** | | | |
| 1.6% | **0.2289** | 25% | **1.010** *6* | |
| 3% | **0.4106** | 73% | **1.426** *5* | |
| 23% | **0.4626** | 18% | **2.210** *15* | |

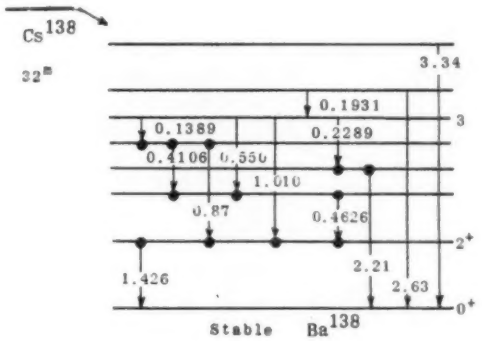
Continued

$Cs^{138}_{55\ 83}$ $32^{m}$

Continued

| | | | | | |
|---|---|---|---|---|---|
| 8% | **0.550** | *6* | 9% | **2.630** | *15* |
| 4% | **0.87** | *1* | 0.5% | **3.34** | *4* |

(1.426 γ)(0.139, 0.411, 0.463, 0.550, 0.87, 1.010γ) No (1.426 γ)(2.21, 2.63γ)
(0.229 γ)(2.21γ) No γ(2.63γ)
(0.463 γ)(0.139, 0.411, 0.550γ)
(0.139 γ)(0.87γ) No (0.463 γ)(1.010 γ)
(1.010 γ)(1.426 γ)(θ) J = 3, 2, 0



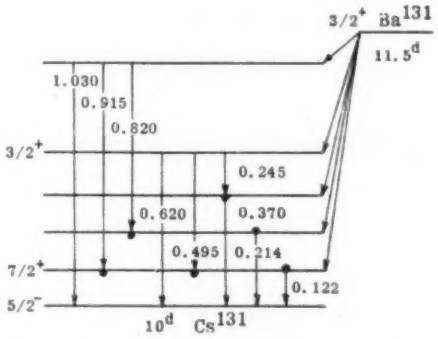

56B101 M.E.Bunker, R.B.Duffield, J.P.Mize, J.W.Starner, Phys. Rev. 103, 1417 (1956); 100, 1236A (1955).

$Ba^{131}_{56\ 75}$ $11.5^{d}$

γ($Cs^{131}$) ~0.083? scin

| | | | |
|---|---|---|---|
| **0.122** | $\alpha_K$ = 0.39 *4* | | |
| **0.214** | | **0.620** | |
| **0.245** | | **0.820** | |
| **0.370** | | **0.915** | |
| **0.495** | | **1.030** | |

(0.122 γ)(0.495, 0.915γ) (0.214 γ)(0.820γ)
(0.245 γ)(0.370γ) No γ(~0.083γ)
(K x ray)(0.214, 0.245, 0.370γ) delay < $1^{m\mu s}$




56V21 H.Vartapetian, Compt. rend. 243, 1512 (1956).

$Ba^{137}_{56\ 81}$ $2.6^{m}$

γ($Ba^{137}$) **0.661** *2* $\alpha_K$ = 0.11 *1* M4 sπ ce
K/L = 6.0 *1* L/M = 4.1 *4*
27$^{y}$Cs source

55D43 G.M.Drabkin, V.I.Orlov, L.I.Rusinov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 324 (1955), Columbia Tech. Transl. p.293.

$La^{140}_{57\ 83}$ $40^{h}$

γ($Ce^{140}$) $La^{(139)}$(pile n,γ)

| | | | | |
|---|---|---|---|---|
| 18† | **0.335** | | | sπ Cp |
| 39† | **0.482** | 94† | **1.597** | |
| 35† | **0.822** | 5.5† | **2.535** | |
| 11† | **0.918** | <0.2† | >**2.700** | |

†Photons/100 disintegrations

55A45 L.V.Arkhangel'skiĭ, B.S.Dzhelepov, N.N.Zhukovskiĭ, V.P.Prikhodtseva, Yu. V. Khol'nov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 251 (1955), Columbia Tech. Transl. p.228.

$(E_\beta > 1.67)(1.60\gamma)(\theta)$ $\eta(\pi) = 0.133$ *16* scin

55J29 E.N.Jensen, ISC-707, 9 (1955).

$Ce^{144}_{58\ 86}$ $284^{d}$

τ **284.5$^{d}$** *10* U(n,f) chem

56S87 R.P.Schuman, M.E.Jones, A.C.Newherter, J. Inorg. Nucl. Chem. 3, 160 (1956).

$Pr^{141}_{59\ 82}$

Level $Pr^{141}(\gamma,\gamma)$
**(0.145)** $\tau = 2.0^{m\mu s}$ *3*
E2/M1 < 0.06 for 0.145γ γγ(θ)
τ(half-life) is average of result of heating and rotating $Ce^{141}$ source to compensate for recoil and calc. using α = 0.26 for 0.145γ

56M76 F.R.Metzger, J. Franklin Inst. 261, 219 (1956); Phys. Rev. 99, 613A (1955).

$Pr^{142}_{59\ 83}$ $19^{h}$

$(0.4 < E_\beta < 0.5)(1.57\gamma)(\theta)$ $\eta(\pi) = -0.058$ *14* scin

55J29 E.N.Jensen, ISC-707, 9 (1955).

$Pr^{144}_{59\ 85}$ $17.5^{m}$

284$^{d}$$Ce^{144}$ source

| | | |
|---|---|---|
| $\beta^-$ | **2.28** | scin βγ |
| | **2.99** | sl |

If $J = 0^-$ for $Pr^{144}$ g.s., $G_T/G_P \sim 0.01$ required to explain shape of 2.99β

56L39 M.J.Laubitz, Proc. Phys. Soc. 69A, 789 (1956).

$Pm^{147}_{61\ 86}$ $2.6^{y}$

τ **2.66$^{y}$** *2* U(n,f) chem
Not corrected for ~1% $1.7^{y}Eu^{155}$

56S87 R.P.Schuman, M.E.Jones, A.C.Newherter, J. Inorg. Nucl. Chem. 3, 160 (1956).

τ **2.64$^{y}$** *2*

57M47 W.F.Merritt, P.J.Campion, R.C.Hawkings, Can. J. Phys. 35, 16 (1957).

$\beta^-$ **0.218** *5* sl

56N21 T.D.Nainan, H.G.Deware, A.Mukerji, Proc. Indian Acad. Sci. 44A, 111 (1956).

$Sm^{145}_{62\ 83}$ $\tau$ $\sim 240^{d}$ $Sm^{144}$(pile n)

$\sim 240^{d}$ $\gamma(Pm^{145})$ **0.0613** cryst, scin

x $Pm\ K_{\alpha 1}, K_{\alpha 2}, K_{\beta 1}, K_{\beta 2}$ x rays

(0.061$\gamma$)(K x ray) (K x ray)(K x ray)

No $\beta^-$, no $\beta^+$, no $\alpha$, no other $\gamma$

57C01 G.W.Callendine, Jr., W.E.Carey, M.L.Pool, Bull. Am. Phys. Soc. 2, No. 1, 24 G8 (1957); verbal report.

$Sm^{152}_{62\ 90}$ Level $Sm^{(152)}(\gamma,\gamma)$ $Eu^{152}$ $\gamma$ source

**(0.976)** $\tau = 12^{m\mu s}$ 2

56G48 L.Grodzins, Bull. Am. Phys. Soc. 1, No. 7, 329 J7 (1956); verbal report.

0.122 level

$|\mu|$ **0.72** *1* p,$\gamma(\theta$,H)

Used $\tau = 1.37^{m\mu s}$

57S16 R.P.Scharenberg, G.Goldring, Bull. Am. Phys. Soc. 2, No. 1, 69 XA6 (1957); verbal report.

$Sm^{153}_{62\ 91}$ $47^{h}$ $\beta^-$ $\sim$0.06% **0.13** 38% **0.720** *10* scin

40% **0.645** *10* 22% **0.825** *10*

$\gamma(Eu^{153})$

25† **0.070** $\alpha_K = 4.4$ *4* scin $\gamma$,$\gamma$x/$\gamma\gamma$

100† **0.100** $\alpha_K = 1.19$ *15* $\gamma$,x/$\gamma$

0.073† **0.170** scin

0.15† **0.53**

0.036† **0.60**

(0.13 $\beta$)(0.53, 0.60$\gamma$)

(0.645 $\beta$)(0.070, 0.170$\gamma$) (0.720 $\beta$)(0.100$\gamma$)

(0.070 $\gamma$)(0.100, 0.53$\gamma$) (0.100 $\gamma$)(0.53, 0.60$\gamma$)

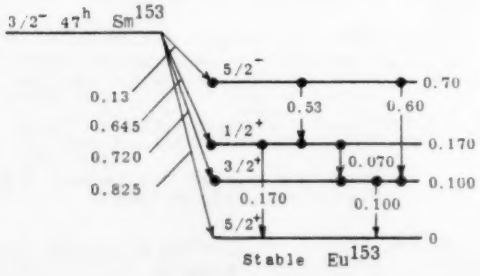
No (0.825 $\beta$)$\gamma$ No (0.070 $\gamma$)(0.60$\gamma$)

56D31 V.S.Dubey, C.E.Mandeville, M.A. Rothman, Phys. Rev. 103, 1430 (1956); Bull. Am. Phys. Soc. 1, No. 4, 164 B12 (1956).

$\beta$(0.069$\gamma$) delay $< 1^{m\mu s}$ scin

(0.069 $\gamma$)(0.103$\gamma$) delay $= 4.0^{m\mu s}$ 2

56V19 M.Vergnes, N.Marty, J. phys. radium 17, 908 (1956).




56D31 V.S.Dubey, C.E.Mandeville, M.A. Rothman, Phys. Rev. 103, 1430 (1956); Bull. Am. Phys. Soc. 1, No. 4, 164 B12 (1956).

Eu 63 $\gamma(Gd^{152,154}, Sm^{152,154})$ $Eu^{152,154}$ source

| | | | | |
|---|---|---|---|---|
| 86† | **0.341** | 34† | **0.871** | Sm Cp |
| 14† | **0.427** | 96† | **0.958** | |
| 10† | **0.593*** | 119† | **1.106** | |
| 21† | **0.717** | 43† | **1.281** | |
| 60† | **0.779** | 100† | **1.409** | |

*Composite

55D42 B.S.Dzhelepov, N.N.Zhukovskiĭ, V.G. Nedovesov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 296 (1955), Columbia Tech. Transl. p.269.

$Eu^{151}_{63\ 88}$ Reaction $\gamma$'s $Eu^{151}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

0.195 level B(E2) = 0.05 2 scin $\gamma$

**0.195** 2

0.304 level B(E2) = 0.28 *9*

**0.110** *1*

10† **0.195** 2

90† **0.304** *3*

(0.110 $\gamma$)(0.195$\gamma$)

56H75 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150 (1955); Bull. Am. Phys. Soc. 1, No. 4, 164 C3 (1956).

$Eu^{152}_{63\ 89}$ $13^{y}$ E.S. $\gamma(Sm^{152})$ **0.12179** cryst

**0.24484**

56B123 F.Boehm, E.N.Hatch, Bull. Am. Phys. Soc. 1, No. 8, 390 M7 (1956); verbal report.

$Eu^{152}_{63\ 89}$ $9.2^{h}$ **(0.854 $\gamma$)(0.122 $\gamma$)($\theta$)** J = 1, 2, 0 scin

56G48 L.Grodzins, Bull. Am. Phys. Soc. 1, No. 7, 329 (1956); verbal report.

$Eu^{152}_{63\ 89}$ Resonance $Eu^{(151)}$(n)

| $E_o$(ev) | $\Gamma_\gamma$(mev) | |
|---|---|---|
| **3.72** | 69 *7* | cryst |

Isotope assignment by use of enriched $Eu^{151}$*

56L34 H.H.Landon, Bull. Am. Phys. Soc. 1, No. 7, 347 X9 (1956); *J.A.Harvey, ibid

$Eu^{153}_{63\ 90}$ Reaction $\gamma$'s $Eu^{153}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

0.082 level B(E2) = 2.8 9 scin $\gamma$

**0.082** *1*

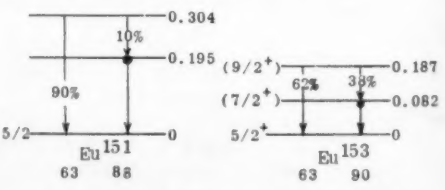
0.187 level B(E2) = 0.8 2

**0.082** *1*

100† **0.105** *1*

162† **0.187** 2

(0.105 $\gamma$)(0.082$\gamma$)




56H79 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150 (1955); Bull. Am. Phys. Soc. 1, No. 1, 43 K11 (1956).

$Eu^{153}_{63\ 90}$ Levels $Eu^{(153)}(p,p'\gamma)$, $E_p = 2.5,\ 2.9$

[B(E2) 0.187 level]/[B(E2) 0.082 level] = 0.225

From $0.105\gamma/0.082\gamma = 0.0465$ *30*,
$0.187\gamma/0.105\gamma = 1.30$ *2*
assuming $\alpha(M1) = 0.8$ of Rose's calc. value

56G47 G.Goldring, G.T.Paulissen, Phys. Rev. 103, 1314 (1956); priv. comm.

$Eu^{154}_{63\ 91}$ $^{16^y}$

| | | |
|---|---|---|
| $\gamma(Gd^{154})$ | **0.12307** | cryst |
| | **0.24808** | |

56B123 F.Boehm, E.N.Hatch, Bull. Am. Phys. Soc. 1, No. 8, 390 M7 (1956); verbal report.

$Eu^{154}_{63\ 91}$ **Ground state** $Eu^{153}$(pile n,$\gamma$)

J **3** para

$|\mu(Eu^{154})/\mu(Eu^{153})| = 1.308$ *4*

56K35 R.W.Kedzie, M.Abraham, C.D.Jeffries, Bull. Am. Phys. Soc. 1, No. 8, 390 M11 (1956).

Resonances $Eu^{(153)}$(n)

| $E_o$(ev) | $\Gamma_\gamma$(mev) | |
|---|---|---|
| **2.455** | 89 *2* | cryst |
| **3.94** | 91 *5* | |

Isotope assignment by use of enriched $Eu^{153}$.

56L34 H.H.Landon, Bull. Am. Phys. Soc. 1, No. 7, 347 X9 (1956); *J.A.Harvey, ibid.

$Eu^{155}_{63\ 92}$ $^{1.7^y}$

| | | | |
|---|---|---|---|
| $\beta^-$ | 77% | **0.15** *1* | scin |
| | 23% | **0.24** *1* | |
| $\gamma(Gd^{155})$ | | **0.084** | scin |
| | | **0.102** | |
| x | | **L x ray** | scin |
| | | **K x ray** | scin |

$\beta$x, x,xx

(0.15 $\beta$)(0.084, 0.102$\gamma$, L x ray, K x ray)
(L x ray)(0.084$\gamma$, K x ray) No (0.24 $\beta$)($\gamma$, x)
No (0.084 $\gamma$)(0.102$\gamma$, K x ray)
No (0.102 $\gamma$)(K x ray)

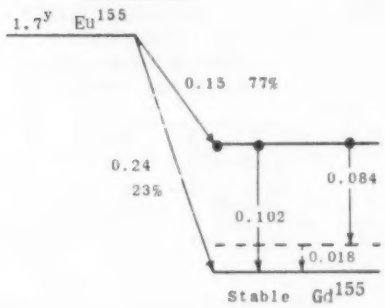
Observed higher energy $\beta$'s and $\gamma$'s were attributed to $Eu^{152}$ and $Eu^{154}$

56D31 V.S.Dubey, C.E.Mandeville, M.A. Rothman, Phys. Rev. 103, 1430 (1956); Bull. Am. Phys. Soc. 1, No. 4, 164 B12 (1956).

Continued

$Eu^{155}_{63\ 92}$ $^{1.7^y}$

Continued




56D31 V.S.Dubey, C.E.Mandeville, M.A. Rothman, Phys. Rev. 103, 1430 (1956); Bull. Am. Phys. Soc. 1, No. 4, 164 B12 (1956).

$Eu^{156}_{63\ 93}$ $^{14^d}$

| | | | |
|---|---|---|---|
| $\beta^-$ | **2.45** *5* | | $Eu^{(153)}$(pile n); s |
| $\gamma(Gd^{156})$ | **0.08897** *1* | | cryst |
| | **0.19919** *2* | | |
| | **0.585?** | **1.130** | sl pe |
| | **0.630** | **1.150** | **1.972** |
| | **0.690** | **1.240** | **2.033** |
| | **0.723** | **1.250** | **2.070** |
| | **0.808** | **1.270** | **2.094** |
| | **0.960** | **1.744** | **2.128** |
| | **1.027** | **1.778** | **2.169** |
| | **1.075** | **1.948** | **2.182** |

Photon energies $\geq$ 0.585 have errors of 0.010

56B123 F.Boehm, E.N.Hatch, Bull. Am. Phys. Soc. 1, No. 8, 390 M7 (1956); verbal report.

$Gd^{153}_{64\ 89}$ $^{236^d}$ (K x ray)(0.098$\gamma$) delay $< 1^{m\mu s}$ scin

56V19 M.Vergnes, N.Marty, J. phys. radium 17, 908 (1956).

$Gd^{154}_{64\ 90}$ Reaction $\gamma$ $Gd^{(154)}(p,p'\gamma)$ $E_p = 1.75$

**0.124** *1* $\epsilon B(E2) = 0.7$ *3* sd $ce_L$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$ $Gd^{154}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

**0.123** *1* $\epsilon B(E2) = 1.9$ *6* scin $\gamma$

56H78 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150; 98, 1198A (1955).

$Gd^{155}_{64\ 91}$ **Ground state**

J **3/2** para

$|\mu|$ **0.24** **4*

$|\mu(Gd^{155})/\mu(Gd^{157})| = 0.75$ *7*

$|\mu(Eu^{151})/\mu(Gd^{157})| = 11.3$

*Using $\mu(Eu^{151}) = 3.6$

56L29 W.Low, Phys. Rev. 103, 1309 (1956).

$Gd^{155}$ 64 91

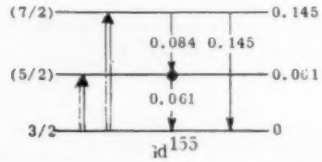
Reaction $\gamma$'s $Gd^{155}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

0.145 level B(E2) = 1.3 4 scin $\gamma$

100† 0.084 1

26† 0.145 2

(K x ray)(K x ray, 0.084$\gamma$)




56H78 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150; 98, 1198A (1955).

$Gd^{156}$ 64 92

Reaction $\gamma$ $Gd^{(156)}(p,p'\gamma)$ $E_p = 1.75$

0.090 1 $\epsilon B(E2) = 2.8$ 7 sd $ce_L$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$ $Gd^{156}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

0.088 1 $\epsilon B(E2) = 0.9$ 3 scin $\gamma$

56H78 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150 (1955).

$Gd^{157}$ 64 93

Ground state

J 3/2 para

$|\mu|$ 0.32*5

$|\mu(Gd^{155})/\mu(Gd^{157})| = 0.75$ 7

$|\mu(Eu^{151})/\mu(Gd^{157})| = 11.3$

*Using $\mu(Eu^{151}) = 3.6$

56L29 W.Low, Phys. Rev. 103, 1309 (1956).

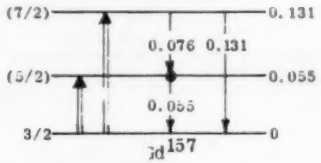
Reaction $\gamma$'s $Gd^{157}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

0.131 level B(E2) = 1.1 3 scin $\gamma$

100† 0.076 1

27† 0.131 1

(K x ray)(K x ray, 0.076$\gamma$)




56H78 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150; 98, 1198A (1955).

$Gd^{158}$ 64 94

Reaction $\gamma$ $Gd^{(158)}(p,p'\gamma)$ $E_p = 1.75$

0.080 1 $\epsilon B(E2) = 3.4$ 8 sd $ce_L$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$ $Gd^{158}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

0.078 1 $\epsilon B(E2) = 0.6$ 2 scin $\gamma$

56H78 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150 (1955).

$Gd^{160}$ 64 96

Reaction $\gamma$ $Gd^{(160)}(p,p'\gamma)$ $E_p = 1.75$

0.076 1 $\epsilon B(E2) = 3.4$ 8 sd $ce_L$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$ $Gd^{160}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$; scin $\gamma$

0.073 1 $\epsilon B(E2) = 0.50$ 15

56H78 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956).

$Tb^{156}$ 65 91 5.0$^h$

$\tau$ 5.0$^h$

$\gamma(Tb^{156})$ 0.0890 S77 ce

Mass assignment from activation data and use of enriched isotopes

56M73 J.W.Mihelich, B.Harmatz, T.H.Handley, J.J.Pinajian, Bull. Am. Phys. Soc. 1, No. 7, 330 J10 (1956); verbal report.

$Tb^{159}$ 65 94

Reaction $\gamma$'s $Tb^{159}(d,d'\gamma)$ $E_d = 1.75$

0.058 1 $\epsilon B(E2) = 0.4$ 2 sd $ce_L$

0.081 1 $= 0.2$ 1

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$'s $Tb^{159}(\alpha,\alpha'\gamma)$ $E_\alpha = 3$ to 6

0.136 level B(E2) = 2.2 7 scin $\gamma$

(0.057)

100† 0.079 ($\alpha = 3.3$)

13† 0.136 1 ($\alpha = 1.0$)

(K x ray)(K x ray, 0.079$\gamma$)

56H79 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150; 98, 1198A (1955); Bull. Am. Phys. Soc. 1, No. 1, 43 K11 (1956).

$Tb^{160}$ 65 95 73$^d$

$\beta^-$ 1† 0.550 (sl $\beta$)(scin $\gamma$)

1† 0.880

(0.550 $\beta$)(0.30, ~0.9$\gamma$) (0.880 $\beta$)(~0.9 $\gamma$)

(0.085 $\gamma$)(~0.9$\gamma$)

55S93 I.P.Stepanenko, L.Ya.Shavtvalov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 318 (1955), Columbia Tech. Transl. p.289.

$Tb^{161}$ 65 96 7.2$^d$

$\tau$ 7.15$^d$ $Gd^{160}$(pile n,$\gamma$)

$\beta^-$ 10% 0.405 10 sd

22% 0.447 10 68% 0.531

| $\gamma(Dy^{161})$ | K : | $L_1$ : | $L_2$ : | $L_3$ | sd ce |
|---|---|---|---|---|---|
| 0.0256 | | 10 : | 7.5 : | 6.3 | |
| 0.0277 | | | | | |
| 0.0489 | | 10 : | 1.6 : | 0.7 | |
| 0.0573 | | 10 : | | 2.5 | |
| 0.0748 | 10: | 5.5: | | 2.2 | |
| 0.0780 | | | | | |
| 0.1062 | | | | | |

(~0.050 $\gamma$)(~0.076, ~0.050, ~0.025 $\gamma$) scin

(~0.025 $\gamma$)(~0.025 $\gamma$)

56C58 J.M.Cork, M.K.Brice, L.C.Schmid, R.G. Helmer, Phys. Rev. 104, 481 (1956); Bull. Am. Phys. Soc. 1, No. 6, 297 R7 (1956).

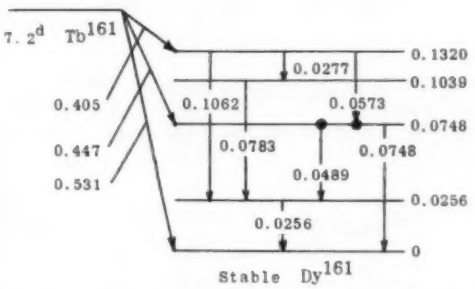
$Tb^{161}$ 65 96 $7.2^d$

Gd(160)(n,γβ) chem

| | | | | | |
|---|---|---|---|---|---|
| $\beta^-$ | 21% | **0.439** | 42% | **0.522** | sπ |
| | 23% | **0.496** | 14% | **0.571** *4* | |
| γ($Dy^{161}$) | | | | | sl ce, scin |
| | 34* | **0.0255** *1* | $L_1:L_2:L_3$ = 1:0.75:1.1 | | |
| | | | $\alpha_L$ = 2.1 | L/MN ~3 | |
| | w | **0.028** | | | |
| | 66* | **0.0489** *1* | L/MN ~3 | E2/M1 < 0.01 | |
| | | **0.0569** *4* | $\alpha_L$ = 0.15 | | |
| | 3.3* | **0.0746** *4* | $\alpha_L$ = 0.064 | K/L ~7 | |
| | w | ~**0.104** | | | *ce per 100 β's |

0.0783γ and 0.1321γ very weak, if present
(~0.050 γ)(~0.025, ~0.075γ)

56S102 W.G.Smith, J.H.Hamilton, R.L.Robinson, J.M.Langer, Phys. Rev. 104, 1020 (1956).




56C58 J.M.Cork, M.K.Brice, L.C.Schmid, R.G. Helmer, Phys. Rev. 104, 481 (1956); Bull. Am. Phys. Soc. 1, No. 6, 297 R7 (1956).

$Dy^{165}$ 66 99 $2.3^h$ s.s.

| | | | |
|---|---|---|---|
| $\beta^-$ | **0.88** | | a |
| | **1.32** | | |

55R57 Y.Robinet, L.Winand, G.Guében, Bull. soc. roy. sci. Liege 24, 313 (1955).

$Ho^{160}$ 67 93 $5.0^h$

| | | |
|---|---|---|
| τ | $5.0^h$ | |
| γ($Ho^{160}$) | **0.0601** | sπ ce |

Mass assignment from activation data and use of enriched isotopes

56N73 J.W.Mihelich, B.Harmatz, T.H.Handley, J.J.Pinajian, Bull. Am. Phys. Soc. 1, No. 7, 330 J10 (1956); verbal report.

$Ho^{165}$ 67 98

Levels $Ho^{165}(p,p'\gamma)$ $E_p$ = 2.9

[B(E2) 0.206 level]/[B(E2) 0.094 level] = 0.195
from 0.112γ/0.094γ = 0.0564 *40*,
0.206γ/0.112γ = 0.14 *1.5*
assuming α(M1) = 0.8 of Rose's calc. value

56G47 G.Goldring, G.T.Paulissen, Phys. Rev. 103, 1314 (1956).

Reaction γ's $Ho^{165}(p,p'\gamma)$ $E_p$ = 1.75
$Ho^{165}(d,d'\gamma)$ $E_d$ = 1.75

| | | | |
|---|---|---|---|
| **0.096** *1* | εB(E2) = 1.6 *8* | | sd $ce_K$ |
| | = 0.32 *8* | | sd $ce_L$ |
| **0.116** *1* | = 0.07 *3* | | sd $ce_L$ |

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

$Ho^{165}$ 67 98

Reaction γ's $Ho^{165}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 3.4, 6

| | | | |
|---|---|---|---|
| 0.094 level | B(E2) = 2.5 | | scin γ |
| **0.094** *1* | | (α = 2.4) | |
| 0.206 level | B(E2) = 0.5 *2* | | |
| **0.094** *1* | | | |
| 100† | **0.112** *1* | (α = 1.3) | |
| 16† | **0.206** *2* | (α = 0.2) | |

(0.112 γ)(K x ray)/(0.112 γ)(0.094γ) ~8

56H79 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150 (1955); 94, 1399 (1954); Bull. Am. Phys. Soc. 1, No. 1, 43 K11 (1956).

Er 68

| | | | |
|---|---|---|---|
| Capture γ's | Er(n,γ) | $E_n$ = 0.46, 0.58, | |
| 35 *9*† | **0.190** *10* | 6.1, 9.5 ev | |
| 6 *2*† | **0.280** *10* | scin | |
| 14 *5*† | **0.750** *25* | | |
| 30 *9*† | **0.820** *20* | | |

†Photons/100 n captures at $E_n$ = 0.46. About same values found at other 3 resonances

57F04 C.A.Fenstermacher, R.L.Hickok, H.L. Schultz, Bull. Am. Phys. Soc. 2, No. 1, 41 NA 1 (1957); verbal report.

$Er^{169}$ 68 101 9.4d

| | | | |
|---|---|---|---|
| $\beta^-$ | **0.330** *10* | Er(168)(pile n,γ); s | |
| γ($Tm^{169}$) | | $M_1:M_2:M_3:M_{45}$ | |
| | (**0.00842**) | 30:10:10: <0.5 | sπ ce |
| No other γ | | M1/E2 = 999 | |
| 15% of β's to 0.00842 level | | | s ce/β |

56H72 E.N.Hatch, F.Boehm, Bull. Am. Phys. Soc. 1, No. 8, 390 M6 (1956); verbal report.

$Er^{171}$ 68 103 7.8h

| | | | | | |
|---|---|---|---|---|---|
| τ | | $7.80^h$ *15* | Er(170)(pile n,γ) | | |
| $\beta^-$ | ~ 2% | **0.58** | 93% | **1.05** | sl |
| | ~ 1% | **0.87** | 3% | **1.49** | |
| γ($Tm^{171}$) | | | | | sπ ce |
| | 300* | **0.1115** | $K:L_1:M_1$ = 25:7:1 | | |
| | 6* | **0.1165** | $K:L_{23}$ = 1:2 | | |
| | 47* | **0.1238** | $K:L_2:L_3:M_{23}$ = 47:54:41:14 | | |
| | | **0.210** | | | scin γγ |
| | | **0.285** | | | |
| | 16* | **0.2954** | | | sl ce |
| | 20* | **0.3075** | | | |
| | 1† | **0.685** | | | scin |
| | 1† | **0.795** | | | |
| | 1† | **0.906** | | | |

(0.124 γ)(0.295 γ) (0.307 γ)(0.111γ, 0.116γ)
(~0.113 γ)(0.210 γ)(0.285 γ)
No 0.085γ
*Relative $ce_K$ intensities
†Relative to 100 for 0.295 + 0.307 photons

56C62 F.P.Cranston, M.E.Bunker, J.P.Mize, J.W.Starner, Bull. Am. Phys. Soc. 1, No. 8, 389 M5 (1956); verbal report.

$Tm^{170}$ 69 101 127d

| | | | |
|---|---|---|---|
| $\beta^-$ | 22% | **0.882** *10* | sl |
| | 78% | **0.957** *7* | |

56N21 T.D.Nainan, H.G.Deware, A.Mukerji, Proc. Indian Acad. Sci. 44A, 111 (1956).

$Tm^{170}_{69\ 101}$ $Tm^{169}(n)$ $E_n$ = 0.038 to 1.56 ev

No resonances observed cryst

56J27 E.G.Joki, J.E.Evans, Phys. Rev. 103, 1326 (1956).

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Yb $\tau$ $\sim 13^d$

70 $\gamma$(Yb) **0.0758** sπ ce

56M73 J.W.Mihelich, B.Harmatz, T.H.Handley, J.J.Pinajian, Bull. Am. Phys. Soc. 1, No. 7, 330 J10 (1956); verbal report.

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$Yb^{169}_{70\ 99}$ $31^d$

| | | | |
|---|---|---|---|
| $\gamma(Tm^{169})$ | **0.00817** | $Yb^{(168)}$(pile n,$\gamma$) | |
| | **0.02073** | | sπ ce |
| | **0.0450** | | |
| | **0.06302** | $L_1:L_2:L_3$ = 23:8:10 | |
| | | $\alpha_L$ = 0.19 *4* | E1 |
| | **0.09357** | $L_1:L_2:L_3$ = 100:18:$10^{\$}$ | |
| | | $\alpha_K > 0.83$ $\alpha_L$ = 0.34 *5* | |
| 1750* | **0.1098** | $L_1:L_2:L_3$ = 167:30:10 | |
| | | $\alpha_K \sim 1.3$ $\alpha_L$ = 0.30 *6* | |
| 90* | **0.1182** | $L_2/L_3$ = 1.1 | E2 |
| 410* | **0.1307** | $L_1:L_2:L_3$ = 28:128:100 | |
| | | $\alpha_L$ = 0.53 *5* | E2 |
| 680* | **0.1777** | $L_1/L_3 \sim 10$ | |
| | | $\alpha_K$ = 0.5 *1* $\alpha_L > 0.084$ | |
| 928* | **0.1986** | $L_1/L_3 \sim 10$ | |
| | | $\alpha_K$ = 0.45 *9* $\alpha_L > 0.068$ | |
| ~3* | **0.2621** | | |
| 34* | **0.3084** | $\alpha_K$ = 0.059 *12* | E2 |

(0.063 $\gamma$)(X > 0.110$\gamma$) delay = 0.64$^{\mu s}$ *4*

(0.094 $\gamma\gamma$)(0.063$\gamma$) delay = 0.045$^{\mu s}$

(K x ray)(0.063$\gamma$) delay = 0.4$^{\mu s}$ and 0.045$^{\mu s}$

α's based on $\alpha_K$(0.130$\gamma$) = 0.47 and photon data of S.A.E.Johannson**

$Used $L_2/L_3$ = 1.8

*Relative ce$_K$ intensities

J.W.Mihelich, T.J.Ward, K.P.Jacob, Phys. Rev. 103, 1285 (1956); **S.A.E.Johannson, Phys. Rev. 100, 835 (1955).

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$\gamma(Tm^{169})$ s ce; cryst

| | | | |
|---|---|---|---|
| | **0.00842** *5* | | |
| | **0.02075** *5* | $L_1:L_2:L_3$ = 200:25:10 | |
| 65† | **0.06312** *1* | $\alpha_{L_1}$ = 0.10 | $\alpha_{L_2}$ = 0.02 |
| | | $\alpha_{L_3}$ = 0.03 | E1 |
| 4.4† | **0.09360** *4* | $\alpha_K$ = 2.4 | M1 (+E2?) |
| | | $\alpha_{L_1}$ = 0.42 | |
| 22† | **0.10978** *2* | $\alpha_K$ = 2.1 | M1/E2 > 32 |
| | | $\alpha_{L_1}$ = 0.34 | |
| 2.6† | **0.11820** *3* | $\alpha_K$ = 0.66 | E2 |
| 15† | **0.13053** *3* | $\alpha_{L_2}$ = 0.31 | E2 |
| | | $\alpha_{L_3}$ = 0.27 | |
| 31† | **0.17724** *5* | $\alpha_K$ = 0.51 | M1/E2 > 4 |
| | | $\alpha_{L_1}$ = 0.09 | |
| 51† | **0.19797** *6* | $\alpha_K$ = 0.40 | M1/E2 > 4 |
| | | $\alpha_{L_1}$ = 0.07 | |
| 1† | **0.2404** *7* | | E1? |
| 8† | **0.2610** *5* | | E1? |
| 18† | **0.3077** *5* | $\alpha_K$ = 0.04, $\alpha_L$ = 0.01 | E2 |

α's based on Sliv's calculated $\alpha_K$(E2) = 0.54 for 0.130$\gamma$

56H68 E.N.Hatch, F.Boehm, P.Marmier, J.W.M. DuMond, Phys. Rev. 104, 745 (1956); Bull. Am. Phys. Soc. 1, No. 4, 170 E1 (1956).

Continued

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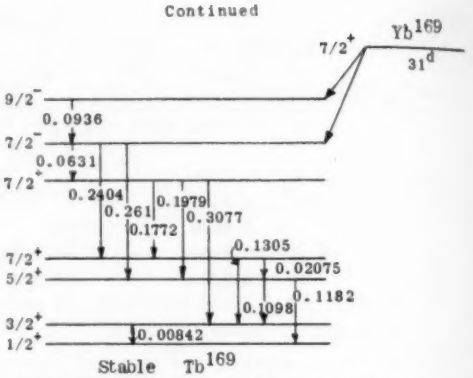
$Yb^{169}_{70\ 99}$ $31^d$ Continued




56H68 E.N.Hatch, F.Boehm, P.Marmier, J.W.M. DuMond, Phys. Rev. 104, 745 (1956); Bull. Am. Phys. Soc. 1, No. 4, 170 E1 (1956).

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$Yb^{175}_{70\ 105}$ $4.2^d$ $\beta$(0.282, 0.396$\gamma$) delay = 3.4$^{m\mu s}$ *3* scin

57V01 H.Vartapetian, Compt. rend. 244, 65 (1957).

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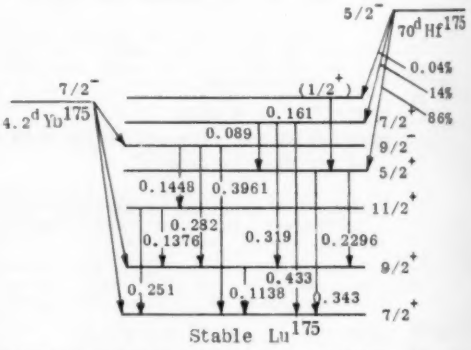
$\gamma(Lu^{175})$ s ce; cryst

| | | | |
|---|---|---|---|
| 31† | **0.11381** *2* | $\alpha_K$ = 1.6 | M1/E2 = 4 |
| | $\alpha_{L1}$ = 0.39 | $\alpha_{L2}$ = 0.10 | $\alpha_{L3}$ = 0.13 |
| 2.2† | **0.13765** *5* | $\alpha_K$ = 1.0 | M1 + E2 |
| 5.9† | **0.14485** *3* | $\alpha_K$ = 0.11 | E1 |
| 3.8† | **0.2513** *5* | | |
| 62† | **0.28257** *13* | $\alpha_K$ = 0.030 | E1/M2 = 49 |
| | | $\alpha_L$ = 0.0037 | |
| 100† | **0.3961** *3* | $\alpha_K$ = 0.067 | E1/M2 = 4 |
| | | $\alpha_L$ = 0.0085 | |

α's based on $\alpha_K$(E2) = 0.54 for $31^d Yb^{169}$ 0.130$\gamma$




56H68 E.N.Hatch, F.Boehm, P.Marmier, J.W.M. DuMond, Phys. Rev. 104, 745 (1956); Bull. Am. Phys. Soc. 1, No. 4, 170 E2 (1956).

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$Lu^{175}_{71\ 104}$ Reaction $\gamma$'s $Lu^{(175)}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 6

| | | | |
|---|---|---|---|
| 0.114 level | | B(E2) = 2.5 *8* | scin |
| | **0.114** *1* | | ($\alpha$ = 2.1) |
| 0.250 level | | B(E2) = 0.8 *2* | |
| | **0.114** *1* | | |
| 100† | **0.136** *1* | | ($\alpha$ = 2.0) |
| 50† | **0.250** *2* | | ($\alpha$ = 0.1) |

(0.136$\gamma$)(0.114$\gamma$)

56H79 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150 (1955); Bull. Am. Phys. Soc. 1, No. 1, 43 K11 (1956).

$Lu^{175}$ 71 104

Reaction $\gamma$ $Lu^{(175)}(p,p'\gamma)$ $E_p = 1.75$

**0.114** *1* $\epsilon B(E2) = 0.36$ *9* sd $ce_L$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Levels $Lu^{(175)}(p,p'\gamma)$ $E_p = 2.9$

[B(E2) 0.250 level]/[B(E2) 0.114 level] = 0.23

from $0.136\gamma/0.114\gamma = 0.0484$ *30*,

$0.250\gamma/0.136\gamma = 0.90$ *15*

assuming $\alpha(M1) = 0.8$ of Rose's calc. value

56G49 G.Goldring, G.T.Paulissen, Phys. Rev. 103, 1314; Bull. Am. Phys. Soc. 1, No. 6, 282 B12 (1956).

Hf 72

Reaction $\gamma$'s $Hf(p,p'\gamma)$ $E_p = 1.75$

**0.095** *1* $\epsilon B(E2) = 2.3$ *9* sd $ce_L$

Average for $Hf^{178}$ and $Hf^{180}$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

$Hf^{175}$ 72 103 $70^d$

$\gamma(Lu^{175})$ s ce; cryst

| | | | | | |
|---|---|---|---|---|---|
| 40† | **0.08936** | *1* | $\alpha_K = 2.2$ | $\alpha_{L12} = 0.43$ | M1/E2 = 32 $\alpha_{L3} = 0.022$ |
| 3.6† | **0.11381** | *5* | $\alpha_K \sim 2$ | $L_{12}/L_3 \sim 6$ | M1/E2 = 9 |
| | | | $\alpha_K$ | $\alpha_L$ | |
| 0.3† | **0.1613** | *2* | 0.5 | 0.2 | |
| 7.3† | **0.2296** | *6* | 0.11 | 0.05 | E2 |
| | **0.3189** | *6* | | | M1/E2 |
| 1000† | **0.34340** | *8* | 0.105 | 0.019 | >3 |
| 16† | **0.4330** | *5* | 0.061 | 0.0095 | >3 |

$\alpha$'s based on $\alpha_K(E2) = 0.49$ for $46^d Hf^{181}$ 0.133$\gamma$

56H68 E.N.Hatch, F.Boehm, P.Marmier, J.W.M. DuMond, Phys. Rev. 104, 745 (1956); Bull. Am. Phys. Soc. 1, No. 4, 170 E2 (1956).

$Hf^{177}$ 72 105

Reaction $\gamma$ $Hf^{(177)}(p,p'\gamma)$ $E_p = 1.75$

**0.114** *1* $\epsilon B(E2) = 0.5$ *2* sd $ce_L$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$'s $Hf^{177}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

| | | | |
|---|---|---|---|
| 0.112 level | B(E2) = 3.4 *10* | | scin |
| **0.112** *1* | | ($\alpha = 2.7$) | |
| 0.250 level | B(E2) = 0.56 *17* | | |
| **0.112** *1* | | | |
| 100† | **0.138** *1* | ($\alpha = 1.1$) | |
| 262† | **0.250** *2* | ($\alpha = 0.1$) | |

(0.138 $\gamma$)(0.112$\gamma$)

56H79 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150; 98, 1198A (1955); Bull. Am. Phys. Soc. 1, No. 1, 43 K11 (1956).

$Hf^{177}$ 72 105

Levels $Hf^{177}(p,p'\gamma)$ $E_p = 2.9$

[B(E2) 0.250 level]/ B(E2) 0.112 level] = 0.32

from $0.138\gamma/0.112\gamma = 0.034$ *3*,

$0.250\gamma/0.138\gamma = 4.3$ *6*

assuming $\alpha(M1) = 0.8$ of Rose's calc. value

56G47 G.Goldring, G.T.Paulissen, Phys. Rev. 103, 1314 (1956).

$Hf^{178}$ 72 106

Capture $\gamma$'s $Hf^{(177)}(n,\gamma)$ scin

| $E_\gamma$ | $E_n = 1.10$ev | $E_n = 2.4$ev |
|---|---|---|
| **0.090** *5* | 15 *3*† | 12 *4*† |
| **0.22** *1* | 42 *8*† | 39 *8*† |
| **0.33** *1* | <13 † | 13 *4*† |

†Photons/100 Hf captures

57B108 C.K.Bockelman, C.A.Fenstermacher, J.E.Draper, Bull. Am. Phys. Soc. 2, No. 1, 41 NA2 (1957); verbal report.

$Hf^{179}$ 72 107

Reaction $\gamma$ $Hf^{(179)}(p,p'\gamma)$ $E_p = 1.75$

**0.123** *1* $\epsilon B(E2) = 0.3$ *1* sd $ce_L$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$'s $Hf^{179}(\alpha,\alpha'\gamma)$ $E_\alpha = 6$

| | | | |
|---|---|---|---|
| 0.119 level | B(E2) = 2.6 *9* | | scin |
| **0.119** *1* | | ($\alpha = 2.5$) | |
| 0.260 level | B(E2) = 0.23 *7* | | |
| **0.119** *1* | | | |
| 100† | **0.141** *2* | ($\alpha = 2.0$) | |
| 44† | **0.260** *3* | ($\alpha = 0.1$) | |

(0.141 $\gamma$)(0.119$\gamma$)

56H79 N.P.Heydenburg, G.M.Temmer, Phys. Rev. 104, 981 (1956); 100, 150; 98, 1198A (1955); Bull. Am. Phys. Soc. 1, No. 1, 43 K11 (1956).

Levels $Hf^{179}(p,p'\gamma)$ $E_p = 2.9$

[B(E2) 0.260 level]/[B(E2) 0.119 level] = 0.22

from $0.141\gamma/0.119\gamma = 0.048$ *4*,

$0.260\gamma/0.141\gamma = 0.50$ *7*

assuming $\alpha(M1) = 0.8$ of Rose's calc. value

56G49 G.Goldring, G.T.Paulissen, Phys. Rev 103, 1314; Bull. Am. Phys. Soc. 1, No. 6, 282 B12 (1956).

$Hf^{181}$ 72 109 $46^d$

$\gamma(Ta^{181})$

| | | |
|---|---|---|
| **(0.1330)** | E2 = 100% | scin $\gamma\gamma(\theta)$ |
| **(0.1362)** | E2/M1 = 0.20 *4* | |
| **(0.3458)** | E2 = 100% | |
| **(0.4820)** | E2/M1 = 43 *9* | |

(0.133 $\gamma$)(0.345 $\gamma$)($\theta$) J = 1/2, 5/2, 9/2

(0.345 $\gamma$)(0.136 $\gamma$)($\theta$) J = 5/2, 9/2, 7/2

(0.133 $\gamma$)(0.482 $\gamma$)($\theta$) J = 1/2, 5/2, 7/2

No (0.476 $\gamma$)(0.482$\gamma$)

56D43 P.Debrunner, E.Heer, W.Kündig, R. Rüetschi, Helv. Phys. Acta 29, 463 (1956).

$Hf^{181}_{72\ 109}$ $46^d$

(ce 0.133 $\gamma$)(0.482 $\gamma$) delay = $8.6^{m\mu s}$ *10* scin

55B148 E.E.Berlovich, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 343 (1955), Columbia Tech. Transl. p.305.

$Ta^{179}_{73\ 106}$ $\sim 600^d$

x 46 4† L x ray Hf(26-Mev d); chem
100 † $K_\alpha$ x ray pc
$E_\epsilon = 0.094^{+9}_{-4}$
No 0.12$\gamma$ ($<0.02$†) No 0.74$\gamma$ scin
Used $\omega_K = 0.94$; $\omega_L = 0.20$; $n_{KL} = 0.81$
$n_{KL}$ = number of L vacancies per K hole

56B103 A.Bisi, L.Zappa, E.Zimmer, Nuovo Cim. 4, 307 (1956).

$Ta^{181}_{73\ 108}$

Reaction $\gamma$'s $Ta^{(181)}(p,p'\gamma)$ $E_p = 2.0, 2.9$
0.137 level scin
**0.137** *3* $B(\bar{E}2) = 1.8^*5$ ($\alpha = 2.09$)
0.303 level
**0.137** *3*
1.5† **0.165** 4
1† **0.302** 4 $B(E2) = 0.5^*1$ ($\alpha = 0.08$)
*Corrected for anisotropy

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

Levels $Ta^{(181)}(p,p'\gamma)$ $E_p = 3.1$
[B(E2) 0.303 level]/[B(E2) 0.137 level] = 0.22
from 0.166$\gamma$/0.137$\gamma$ = 0.0467 *30*
Assuming 0.303$\gamma$/0.166$\gamma$ = 0.574 *50*
and $\alpha$(M1) = 0.8 of Rose's calc. value

56G49 G.Goldring, G.T.Paulissen, Phys. Rev. 103, 1314; Bull. Am. Phys. Soc. 1, No. 6, 282 B12 (1956).

0.482 level $46^d Hf^{181}$ source
J **5/2** $\gamma\gamma(\theta)$
$\mu$ **+3.25** *17* $\gamma\gamma(\theta,H)$

56D43 P.Debrunner, E.Heer, W.Kündig, R. Rüetschi, Helv. Phys. Acta 29, 463 (1956).

$Ta^{182}_{73\ 109}$ $111^d$ g.s.

$\gamma(W^{182})$ **(0.0677)** (E1 = 100%) $\gamma\gamma(\theta)$
**(1.122)** E2/M1 = 9
(0.0677 $\gamma$)(1.122 $\gamma$)($\theta$) J = 2, 2, 2 scin
(0.0677 $\gamma$)(1.222 $\gamma$)($\theta$) J = 2, 2, 0
(0.1524 $\gamma$)(1.222 $\gamma$)($\theta$) J = 3, 2, 0

56W34 R.C.Williams, K.I.Roulston, Can. J. Phys. 34, 1087 (1956).

$W^{181}_{74\ 107}$ $145^d$

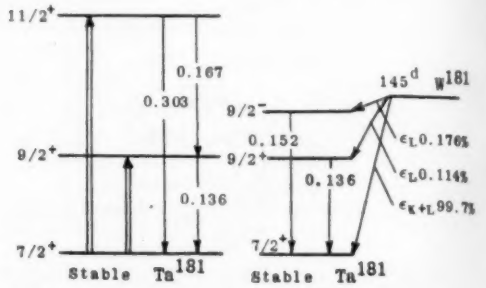
$\gamma(Ta^{181})$ $Ta^{(181)}$(40-Mev d,2n) chem
$\sim 0.11\%^\$$ **0.136** scin $\gamma$, s ce
$\sim 0.17\%^\$$ **0.152** $\alpha_K = 1.0^*2$ E1/M2 = 5.6
No (0.152 $\gamma$)(0.136$\gamma$)
No (K x ray)(0.152, 0.136$\gamma$)
*Using $\alpha_K = 1.2$ for 0.136$\gamma$
$^\$$If (L x ray)/(K x ray) = 0.39

56D32 P.Debrunner, E.Heer, W.Kündig, R. Rüetschi, Helv. Phys. Acta 29, 235A (1956).

$W^{181}_{74\ 107}$ $145^d$

(L x ray)(0.136, 0.152$\gamma$) scin

56D44 P.Debrunner, E.Heer, W.Kündig, R. Rüetschi, T.Lindqvist, Helv. Phys. Acta 29, 432 (1956).




56D32 P.Debrunner, E.Heer, W.Kündig, R. Rüetschi, Helv. Phys. Acta 29, 235A (1956). Coulomb excitation results of others included in level scheme.

$W^{185}_{74\ 111}$ $73^d$ g.s.

$\beta^-$ **0.425** 2 $W^{(184)}$(pile n,$\gamma$); sl
No $ce_K$ 0.134$\gamma$, no $ce_L$ 0.056$\gamma$ sl ce
0.057 photon is Ta K x ray from $145^d W^{181}$ scin
$\sim$ 0.115 peak due to bremsstrahlung scin
0.590$\gamma$ (0.02%) ascribed to unknown impurity

56M93 N.Marty, M.Vergnes, J. phys. radium, 17, 1013 (1956).

$Re^{183}_{75\ 108}$ $70^d$

$\tau$ $70^d$*10 $Ta^{(181)}$(28-Mev $\alpha$,2n) chem

| $\gamma(W^{183})$ | | sm ce |
|---|---|---|
| **(0.04097)** | **(0.16053)** | |
| **(0.04648)** | **(0.16136)** | |
| **(0.05259)** | **(0.16233)** | |
| **(0.08292)** | **(0.19264)** | |
| **(0.08470)** | **(0.20881)** | |
| **(0.09907)** | **0.2453** | |
| **(0.10793)** | **(0.24605)** | |
| **(0.10973)** | **(0.29171)** | |
| **(0.14225)** | **(0.31303)** | |
| **(0.14412)** | **(0.35404)** | |

Energy values in parentheses were taken from the $Ta^{183}$ measurements of Murray et al.** The following $\gamma$'s reported by them were not found in $Re^{183}$ decay:

0.10194, 0.10249, 0.10314, 0.12038, 0.20327, 0.20506, 0.20987, 0.24426, 0.36560, 0.40658

| $E_\gamma$ | $L_1:L_2:L_3$ | E2/(E2 + M1) |
|---|---|---|
| 0.04648 | 120:21:10 | 1 |
| 0.05259 | 86:16:10 | 2 |
| 0.09907 | 11:10 | 100 |
| 0.16233 | 80:18:10 | 23 |

Estimates of ce intensities given

56T22 S.Thulin, J.O.Rasmussen, C.J.Gallagher, Jr., W.G.Smith, J.M.Hollander, Phys. Rev. 104, 471 (1956); *D.Strominger, ibid; **Phys. Rev. 97, 1007 (1955).

$Re^{184}_{75\ 109}$ $50^d$

$Ta^{(181)}$(28-Mev $\alpha$,n) chem
$\gamma(W^{184})$ **0.1112** sm ce

56T22 S.Thulin, J.O.Rasmussen, C.J.Gallagher, Jr., W.G.Smith, J.M.Hollander, Phys. Rev. 104, 471 (1956).

$Re^{185}_{75\ 110}$

Reaction $\gamma$'s $Re^{185}(p,p'\gamma)$ $E_p = 3.2$; scin

0.125 level

**0.125** 4 B(E2) = 0.8 2 ($\alpha$ = 2.85)

0.283 level

**0.125** 4

82 20† **0.158** 5

10† **0.280** 10 B(E2) = 0.4 1 ($\alpha$ = 0.09)

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D. Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

Levels $Re^{185}(p,p'\gamma)$ $E_p = 2.9$

[B(E2) 0.290 level]/[B(E2) 0.130 level] = 0.35

from $0.160\gamma/0.130\gamma = 0.0845$ 60,

$0.290\gamma/0.160\gamma = 0.23$ 5

assuming $\alpha$(M1) = 0.8 of Rose's calc. value

56G49 G.Goldring, G.T.Paulissen, Phys. Rev. 103, 1314; Bull. Am. Phys. Soc. 1, No. 6, 282 B12 (1956).

$Re^{186}_{75\ 111}$ $3.8^d$

$(0.4 < E_\beta < 0.9)(0.137\gamma)(\theta)$ $\eta(\pi)$ = 0.055 5 scin

$(0.4 < E_\beta < 0.6)(0.137\gamma)(\theta)$ = 0.070 6

$(0.6 < E_\beta < 0.9)(0.137\gamma)(\theta)$ = 0.131 14

55J29 E.N.Jensen, ISC-707 p.9 (1955).

$Re^{187}_{75\ 112}$

Reaction $\gamma$'s $Re^{187}(p,p'\gamma)$ $E_p = 3.2$; scin

0.135 level

**0.135** 4 B(E2) = 1.2 3 ($\alpha$ = 2.18)

0.300 level

**0.135** 4

54 15† **0.163** 5

10† **0.300** 10 B(E2) = 0.5 1 ($\alpha$ = 0.07)

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

Levels $Re^{187}(p,p'\gamma)$ $E_p = 2.9$

[B(E2) 0.320 level]/ B(E2) 0.139 level] = 0.28

from $0.181\gamma/0.139\gamma = 0.076$ 5,

$0.320\gamma/0.181\gamma = 0.22$ 5

assuming $\alpha$(M1) = 0.8 of Rose's calc. value

56G49 G.Goldring, G.T.Paulissen, Phys. Rev. 103, 1314; Bull. Am. Phys. Soc. 1, No. 6, 282 B12 (1956).

$Re^{188}_{75\ 113}$ $17^h$ g.s.

| | | | |
|---|---|---|---|
| $\beta^-$ | ~1% | <2 | $Re^{187}$(pile n,$\gamma$); sl |
| | 20% | ~2.0 | scin $\beta$(0.155$\gamma$) |
| | 79% | 2.15 4 | sl |

| $\gamma(Os^{188})$ | | | | |
|---|---|---|---|---|
| 630† | **0.155** | K/L = 0.70 5; $\alpha_K$ = 0.29 3 | | sl ce |
| 67† | **0.478*** | 14† | **1.307** | scin |
| 100† | **~0.63*** | 13† | **1.610** | |
| 35† | **0.828** | 6† | **1.780** | |
| 43† | **0.931** | 3† | **1.805** | |
| 8† | **1.132** | 3† | **1.960** | |

*Complex from $\gamma\gamma$ studies

Continued

$Re^{188}_{75\ 113}$ $17^h$ g.s.

Continued

(0.478 $\gamma$)( ~0.48, ~0.63, 0.828$\gamma$, 1.13$\gamma$) scin

( ~0.63 $\gamma$)(0.48, ~0.63, 0.828$\gamma$, 1.13$\gamma$)

0.931$\gamma$ in coincidence with 0.155$\gamma$ only

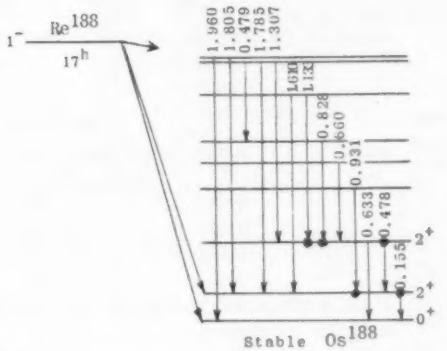
No (0.828 $\gamma$)(1.13$\gamma$)

No ($E_\gamma$ > 1.6)(0.48, ~0.63, 0.828, 0.931$\gamma$)

56P37 V.R.Potnis, Phys. Rev. 104, 722 (1956).

$\gamma(Os^{188})$ **0.15507** 8 cryst

57H01 E.N.Hatch, F.Boehm, priv. comm. 1957.




56P37 V.R.Potnis, Phys. Rev. 104, 722 (1956).

$Re^{189}_{75\ 114}$

No long-lived activity $Re^{(187)}$(pile 2n,$\gamma$)

If $\tau$ = 150$^d$ then $\sigma[Re^{188}(n,\gamma)] \leq 2$

56S86 R.R.Smith, J. Inorg. Nucl. Chem. 3, 157 (1956).

$Os^{185}_{76\ 109}$ $94^d$

| | | | |
|---|---|---|---|
| $\tau$ | **94.3$^d$** 5 | | |
| $\gamma(Re^{185})$ | **0.1603** | | sd pe,ce |
| | **0.2334** | **0.7177** | |
| | **0.5920** | **0.8715** | |
| | **0.6458** | **0.8789** | |

56N18 S.V.Nablo, M.W.Johns, Bull. Am. Phys. Soc. 1, No. 1, 42 K8 (1956).

$Os^{187}_{76\ 111}$? $39^h$

| | | |
|---|---|---|
| $\tau$ | **39$^h$** 2 | $Os^{(187)}$(130-Mev $N^{14}$,$N^{14}$); chem |
| x | **K x ray** | scin |

56G50 G.W.Greenlees, L.G.Kuo, Phil. Mag. 1, 973 (1956).

$Os^{188}_{76\ 112}$? $26^d$

| | | |
|---|---|---|
| $\tau$ | **26$^d$** 2 | $Os^{(188)}$(130-Mev $N^{14}$,$N^{14}$); chem |
| x | **K x ray** | scin |

56G50 G.W.Greenlees, L.G.Kuo, Phil. Mag. 1, 973 (1956).

$Os^{189}$ 76 113 $5.7^h$

$\tau$ **5.7$^h$**

$\gamma(Os^{189})$ **0.0300** $L_{12}/L_3 \leq 0.17$ sl ce
$L_3/M \sim 2$
$\alpha \sim 5000$ M3

d 11$^d$Ir from $Os^{(188)}$(d,n) chem
Not d 11$^d$Ir from $Ir^{(191)}$(n,2n) chem

57S17 G.Scharff-Goldhaber, D.E.Alburger, G.Harbottle, M.McKeown, Bull. Am. Phys. Soc. 2, No. 1, 25 G10 (1957); verbal report.

$Os^{190?}$ 76 114 $7^h$

$\tau$ **7.2$^h$** *10* $Os^{(190)}$(130-Mev $N^{14}$,$N^{14}$); chem

x **K x ray** scin

56G50 G.W.Greenlees, L.G.Kuo, Phil. Mag. 1, 973 (1956).

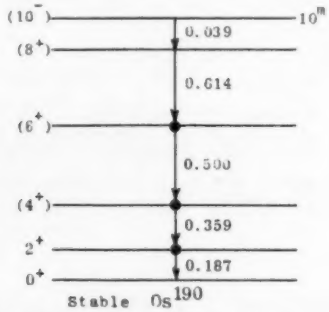
$Os^{190}$ 76 114 $10^m$

$\gamma(Os^{190})$ **0.039** $\alpha > 200$ M2 sl ce
$L_{12}/L_3 \sim 2$

**0.187** *1* E2
**0.359** *2* E2
**0.500** *3* E2
**0.614** *3* E2

0.187, 0.359, 0.500, 0.614 $\gamma$'s in 4-fold coinc.
No 0.653 crossover $\gamma$

$Os^{(189)}$(d,p) chem




57S17 G.Scharff-Goldhaber, D.E.Alburger, G.Harbottle, M.McKeown, Bull. Am. Phys. Soc. 2, No. 1, 25 G10 (1957); verbal report.

$Os^{191}$ 76 115 $15^d$ g.s.

$\tau$ **14.6$^d$** *3*

56N18 S.V.Nablo, M.W.Johns, Bull. Am. Phys. Soc. 1, No. 1, 42 K8 (1956).

$Os^{193}$ 76 117 $31^h$

$\tau$ **31.5$^h$** *1*

$\beta^-$ 10% **0.677** sd
12% **0.855** 33% **1.063**
5% **0.997** 40% **1.136** *5*

$\gamma(Ir^{193})$ **0.2308** sd pe,ce
**0.2807** **0.3876**
**0.3214** **0.4604**
**0.3621** **0.5582**

Study covered $E_\gamma > 0.150$

56N18 S.V.Nablo, M.W.Johns, Bull. Am. Phys. Soc. 1, No. 1, 42 K8 (1956).

$Ir^{191}$ 77 114 $4.9^s$

$\tau$ **4.9$^s$** *1* d 15$^d$$Os^{191}$ chem

56C50 E.C.Campbell, F.Nelson, J. Inorg. Nucl. Chem. 3, 233 (1956).

$Ir^{191}$ 77 114

Reaction $\gamma$ $Ir^{(191)}$(p,p'$\gamma$) $E_p$ = 1.75
**0.129** *1* $\epsilon B(E2) = 0.12$ *5* sd $ce_L$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$'s $Ir^{191}$(p,p'$\gamma$) $E_p$ = 3.2; scin

0.133 level
**0.133** *4* $B(E2) = 0.5$ *1* ($\alpha$ = 2.47)

0.356 level
**0.133** *4*
109 25† **0.216** *6*
100† **0.356** *8* $B(E2) = 0.8$ *2* ($\alpha$ = 0.05)

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

$Ir^{192}$ 77 115 $74^d$ g.s.

$\gamma(Os^{192})$ 1† **1.053** S77 Cp
$\gamma(Pt^{192})$
458† **0.466**
174† **0.58 to 0.62**
<0.2† **0.788?**
3.7† **0.898**
$\gamma$(Os + Pt)
909† **0.20 to 0.32**
No $\gamma$ with $1.6 < E_\gamma < 2.5$ (< 0.02%)

55G62 M.P.Glazunov, B.S.Dzhelepov, Iu. V. Khol'nov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 294 (1955), Columbia Tech. Transl. p.267.

$Ir^{193}$ 77 116

Reaction $\gamma$ $Ir^{(193)}$(p,p'$\gamma$) $E_p$ = 1.75
**0.139** *1* $\epsilon B(E2) = 0.06$ *3* sd $ce_L$

56H49 T.Huus, J.H.Bjerregaard, B.Elbek, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. 30, No. 17 (1956).

Reaction $\gamma$'s $Ir^{193}$(p,p'$\gamma$) $E_p$ = 3.2; scin

0.143 level
**0.143** *4* $B(E2) = 0.5$ *1* ($\alpha$ = 2.02)

0.368 level
**0.143** *4*
32 *8*† **0.230** *6*
100† **0.368** *8* $B(E2) = 0.3$ *1* ($\alpha$ = 0.04)

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

$Pt^{194}$ 78 116

Level $Pt^{(194)}$($\alpha$,$\alpha'\gamma$) $E_\alpha$ = 4.3
[B(E2) 0.620 level]/[B(E2) 0.328 level] $\leq$ 0.0022
from $0.293\gamma/0.328\gamma \leq 3.4 \times 10^{-4}$ scin $\gamma\gamma$

56B137 R.Barloutaud, T.Grjebine, P.Lehmann, A.Lévêque, J.Quidort, G.M.Temmer, Compt. rend. 244, 187 (1956).

$Au^{196}$ 79 117 $5.6^d$

Pt(16-Mev d)

$\gamma(Pt^{196})$ **0.3318** *5* sπ ce
**0.3545** *5*

(0.3318 $\gamma$)(ce$_K$ 0.3545 $\gamma$)($\theta$) (scin $\gamma$)(sl ce)
$\eta(\pi) = +0.084$ *23*

(ce$_K$ 0.3318 $\gamma$)(0.3545 $\gamma$)($\theta$)
$\eta(\pi) = -0.070$ *19*

No E0 contribution to $\eta$ within expt. error

57K02 J.V.Kane, S.Frenkel, Bull. Am. Phys. Soc. 2, No. 1, 25 G11 (1957); verbal report

$Au^{198}$ 79 119 $2.7^d$

$\gamma(Hg^{198})$ sd ce,pe

| | | | |
|---|---|---|---|
| 100 | † | **(0.412)** | |
| 0.97 *11* | † | **(0.676)** | $\alpha_K = 0.019$ *5*<br>M1/E2 ~ 0.6* |
| 0.156 *14* | † | **(1.088)** | $\alpha_K = 0.0046$ *6* E2 |

*Using $\alpha_K$(E2) and $0.7\alpha_K$(M1) of Rose

56V20 J.Volpe, G.Hinman, Phys. Rev. 104, 753 (1956).

$\gamma(Hg^{198})$ $Au^{197}$(n,$\gamma$) sπ Cp

| | | |
|---|---|---|
| 100 | † | **0.412** *4* |
| 1.11 *5* | † | **0.680** *7* |
| 0.26 *2* | † | **1.088** *10* |

55D41 B.S.Dzhelepov, N.N.Zhukovski, V.P. Prikhodtseva, Iu. V. Khol'nov, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 271 (1955); Columbia Tech. Transl. p.247.

$Au^{198}$ 79 119

| Capture $\gamma$'s | | $Au^{197}$(n,$\gamma$) | | | cryst |
|---|---|---|---|---|---|
| 178† | **0.0351** | 10† | **0.2038** | 11† | **0.3110** |
| 22† | **0.0971** | 9† | **0.2078** | 15† | **0.3160** |
| 2† | **0.1449** | 128† | **0.2149** | 30† | **0.3280** |
| 34† | **0.1584** | 6† | **0.2190** | 22† | **0.3430** |
| 3† | **0.1626** | 51† | **0.2352** | 21† | **0.3500** |
| 5† | **0.1660** | 17† | **0.2388** | 9† | **0.3540** |
| 49† | **0.1682** | 77† | **0.2471** | 13† | **0.3700** |
| 19† | **0.1699** | 89† | **0.2698** | 51† | **0.3810** |
| 6† | **0.1805** | 15† | **0.2710** | 18† | **0.4390** |
| 3† | **0.1852** | 14† | **0.2760** | 2.5† | **0.4518** |
| 8† | **0.1877** | 21† | **0.2910** | 2.5† | **0.4906** |
| 48† | **0.1935** | 11† | **0.3080** | 5† | **0.5046** |

†Photons per 1000 n captures

56H61 B.Hamermesh, D.Rose, R.K.Smither, Bull. Am. Phys. Soc. 1, No. 7, 346 X3 (1956); verbal report.

$Hg^{193}$ 80 113 $12^h$

$\beta^+$

$\gamma(Au^{193})$ $Au^{197}$(p,5n); sd

| | | $K/L_1$ | | | $K/L_1$ |
|---|---|---|---|---|---|
| | **0.4997** | | 145* | **0.8787** | 8.1 |
| | **0.5102** | | 102* | **0.9138** | 5.4 |
| | **0.5354** | | 429* | **0.9331** | 6.4 |
| | **0.5373** | | 63* | **0.9969** | 4.8 |
| 2880* | **0.5736** | 4.6 | 35* | **1.113** | |
| 554* | **0.6010** | 5.7 | 48* | **1.175** | |
| 111* | **0.6751** | | 83* | **1.243** | |
| 55* | **0.7013**§ | 2.0 | 50* | **1.328**§ | 2.8 |
| | **0.7618** | | 34* | **1.343**§ | 1.9 |
| 70* | **0.8612** | | 32* | **1.489** | |
| 80* | **0.8708** | | 14* | **1.646** | |

*Relative ce$_K$ intensities §probably double

56B104 J.Brunner, J.Halter, H.J.Leisi, Helv. Phys. Acta, 29, 238A (1956).

$Hg^{195}$ 80 115 $40^h$

$\gamma(Au^{195})$ $Au^{197}$(p,3n)

| | | | |
|---|---|---|---|
| 80* | **0.5256** | $K/L_1 = 5.3$ | sπ, sd ce |
| 1000* | **0.5605** | $K:L_1:M_1 = 100:21:5$ | |
| 110* | **0.5848** | $K/L_1 = 5.0$ | |
| 22* | **0.8210** | | |
| | **1.242** | | |

Energy accuracy 0.2%
*Relative ce$_K$ intensities

56B104 J.Brunner, J.Halter, H.J.Leisi, Helv. Phys. Acta, 29, 238A (1956).

$Hg^{195}$ 80 115 $40^h + 9.5^h$

$\gamma(Au^{195})$ $Au^{197}$(p,3n)

| | | | |
|---|---|---|---|
| 110* | **0.5848** | $K/L_1 = 3.9$ | sπ, sd ce |
| 360* | **0.5995** | $K:L_1:M_1 = 36:8:1$ | |
| 1000* | **0.7804** | $K/L_1 = 4.8$ | |
| 46* | **0.8210** | | |
| | **0.9304** | | |
| 153* | **1.110** | $K/L_1 = 4.2$ | |
| 69* | **1.172** | | |

Energy accuracy 0.2%
*Relative ce$_K$ intensities

56B104 J.Brunner, J.Halter, H.J.Leisi, Helv. Phys. Acta 29, 238A (1956).

$Hg^{198}$ 80 118

Level $Hg^{(198)}(\gamma,\gamma)$ $Au^{198}$ at 1125°C
**(0.411)** J = 2 $\gamma\gamma(\theta)$
$\tau = 21^{\mu\mu s}$ *2*

$\tau$(half-life) calc. using $\alpha = 0.04$ for 0.411 $\gamma$

56M80 F.R.Metzger, J. Franklin Inst. 261, 219 (1956); Phys. Rev. 97, 1258; 98, 1186A (1955); F.R.Metzger, W.B.Todd, Phys. Rev. 95, 853 (1954).

Level $Hg^{(198)}(p,p'\gamma)$ $E_p = 3.2$; scin
**(0.411)** $\tau = 49^{\mu\mu s}$ *25* ($\alpha = 0.04$)

Yield corrected for anisotropy

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

$Hg^{199}$ 80 119

Level $Hg^{(199)}(\gamma,\gamma)$ $Au^{199}$ at 1000°C
**(0.209)** $\tau = 53^{\mu\mu s}$ *17*

$\tau$ is half-life for level using the transition ratio $0.050\gamma/0.209\gamma = 0.20$ and $\alpha = 0.7$ for 0.209 $\gamma$

56M79 F.R.Metzger, J. Franklin Inst. 261, 219 (1956); F.R.Metzger, W.B.Todd, Phys. Rev. 94, 794A (1954).

**Reaction $\gamma$'s** $Hg^{199}(p,p'\gamma)$ $E_p = 3.2$

| | | |
|---|---|---|
| **0.159** *4* | $\epsilon B(E2) = 0.08$ *2* | scin $\gamma$ |
| **0.209** *5* | $\epsilon B(E2) = 0.04$ *1* | |

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

$Hg^{200}$ 80 120

Level $Hg^{(200)}(p,p'\gamma)$ $E_p = 3.2$; scin

**0.375** *7* $\tau = 72^{\mu\mu s}$ *20* ($\alpha = 0.05$)

Yield corrected for anisotropy

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

$Hg^{202}$ 80 122

Level $Hg^{(202)}(\gamma,\gamma)$ $Tl^{202}$ at 1000°C

**(0.439)** J = 2 $\gamma\gamma(\theta)$

$\tau = 23^{\mu\mu s}$ 5

$\tau$(half-life) calc. using $\alpha = 0.04$ for 0.439$\gamma$

56M78 F.R.Metzger, J. Franklin Inst. 261, 219 (1956); Phys. Rev. 98, 200 (1955).

Level $Hg^{(202)}(p,p'\gamma)$ $E_p = 3.2$; scin

**(0.439)** $\tau = 37^{\mu\mu s}$ *19* ($\alpha = 0.03$)

Yield corrected for anisotropy

56D40 R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

$Hg^{203}$ 80 123 47d

$\tau$ **46.91**d *14* $Hg^{(202)}$ (pile n, $\gamma$)

Source purity checked by scin $\gamma$

56E14 G.G.Eichholz, J.V.Krzyzewski, Can. J. Phys. 34, 1167 (1956).

$\beta\gamma$ delay $< 410^{\mu\mu s}$ scin

55B148 E.E.Berlovich, Izvest. Akad. Nauk Ser. Fiz. SSSR 19, 343 (1955), Columbia Tech. Transl. p.305.

$Hg^{205}$ 80 125 $5.1^m$

| | | |
|---|---|---|
| $\tau$ | **5.1**m *1* | $Hg^{204}(n,\gamma)$ |
| $\beta^-$ | ~1.4 | a $\beta\gamma$ |
| | ~1.6 | a |
| $\gamma(Tl^{205})$ | **0.203** | sm ce |

53B88 B.Burson, J.Cork, W.Jordan, ANL-5140 p.36 (1953).

$Tl^{198}$ 81 117

1.9h level $Au^{197}(\alpha,3n)$

J **7** M

56B113 G.O.Brink, J.C.Hubbs, W.A.Nierenberg, J.L.Worcester, Bull. Am. Phys. Soc. 1, No. 7, 343 R2 (1956).

$Tl^{199}$ 81 118

7.4h ground state $Au^{197}(\alpha,2n)$

J **1/2** M

56B113 G.O.Brink, J.C.Hubbs, W.A.Nierenberg, J.L.Worcester, Bull. Am. Phys. Soc. 1, No. 7, 343 R2 (1956).

$Tl^{200}$ 81 119 $27^h$

| $\gamma_a$ \ $\gamma_b$ | 0.2520 | 0.2890 | 0.3092 | 0.3680 | 0.5794 | 0.7121 | 0.7853 | 0.8286 | 1.2067 | 1.2269 | 1.3623 | 1.5167 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2520 | | Y? | N | Y | N | | N | N | N | N? | N? | |
| 0.2890 | Y? | | | Y | | | | | N | Y | | |
| 0.3092 | N | | | Y | | | | N | Y | N | | |
| 0.3680 | Y | Y | Y | | Y | | | Y | | Y | Y | Y |
| 0.5794 | N | | | Y | | Y? | Y | Y | | | | |
| 0.7853 | | | | | | | | N | | | | |

Coincidences observed (Y), not observed (N)

between (ce $\gamma_a$)(ce $\gamma_b$) (sl ce)(sl ce)

Decay scheme is proposed

56G44 T.R.Gerholm, Arkiv. Fysik 11, 55 (1956)

$Tl^{203}$ 81 122

Level $Tl^{(203)}(\gamma,\gamma)$ $Hg^{203}$ at 103°C

**(0.279)** $\tau = 266^{\mu\mu s}$ 45

$\tau$(half-life) calc. using $\alpha = 0.22$ for 0.279$\gamma$

56M77 F.R.Metzger, J. Franklin Inst. 261, 219 (1956); F.R.Metzger, W.B.Todd, Phys. Rev. 95, 627A (1954).

$Tl^{204}$ 81 123

4.1y ground state $Tl^{(203)}(n,\gamma)$

J **2** M

56B113 G.O.Brink, J.C.Hubbs, W.A.Nierenberg, J.L.Worcester, Bull. Am. Phys. Soc. 1, No. 7, 343 R2 (1956).

**4.1y ground state**

J **2** M

$|\mu|$ **0.062** *6*

56B124 H.G.Bennewitz, W.Paul, P.Toschek, Z. Naturf. 11a, 956 (1956).

$Tl^{208}$ 81 127 $3.1^m$

**No 3.2$\gamma$ (< 0.1% of 2.62$\gamma$)** sm Cp

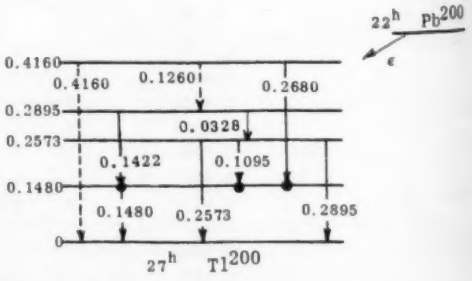
55M98 D.G.E.Martin, G.Parry, Proc. Phys. Soc. 68A, 1177 (1955).

$Pb^{200}$ 82 118 $22^h$

(sl ce)(el ce)

(ce 0.1480 $\gamma$)(ce 0.1095, 0.1422, 0.2353, 0.2680$\gamma$)

No (ce 0.1480 $\gamma$)(ce 0.1589, 0.2573, 0.2895$\gamma$)




56G44 T.R.Gerholm, Arkiv Fysik 11, 55 (1956).

$Pb^{204}$ 82 122 $68^m$

$\tau$ **67.5$^m$** *5* d $12^h Bi^{204}$ chem

$\gamma(Pb^{204})$ 19° **0.2894** *2* Tl(25-Mev d) chem

830°† **0.3747** *4* M3/E2 = 0.003 *2* from $\alpha_K = 0.0444^{\$}$ *29* sd ce

7.0° **0.6222** *2* K/L = 0.74 *9*

130° **0.8993** *3* K/L = 3.9 *4*

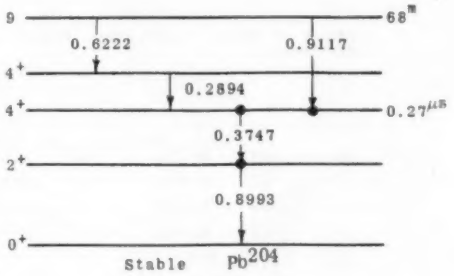
1000° **0.9117** *3* M6/E5 < 0.005 from $\alpha_K = 0.0549^{\$}$ *20*

K/L = 1.7 *8* $L_{12}/L_3$ = 11 *2*

$^{\$}$Used $[\alpha_K(E2)\ 0.899\gamma] = 0.00653$ (Sliv calc.)

†If $(ce_K\ 0.899\gamma + ce_K\ 0.912\gamma) = 1.35(ce_K\ 0.375\gamma)$

°Relative $ce_K$ intensities




56H50 C.J.Herrlander, R.Stockendal, J.A. McDonell, I.Bergström, Nuclear Phys. 1, 643 (1956).

$Pb^{207}$ 82 125 $0.82^s$

$\tau$ **0.84$^s$** *2* d $8.0^y Bi^{207}$ chem

56C50 E.C.Campbell, F.Nelson, J. Inorg. Nucl. Chem. 3, 233 (1956).

$Pb^{210}$ 82 128 $19^y$

$\tau$ **19.40$^y$** *35* differential ic

55T14 J.Tobailem, J. phys. radium 16, 235 (1955); Ann. phys. 10, 783 (1955).

$\beta^-$ chemically pure $Pb^{210}$

84.5 ±3.5% **(0.018)** ppl

15.5 ±3.5% **(0.065)**

$(ce\ 0.046\gamma)/\beta = 0.81$ *4*

56S99 W.Stanners, M.A.S.Ross, Proc. Phys. Soc. 69A, 836 (1956).

$Bi^{205}$ 83 122 $14.5^d$

| $\gamma_a$ \ $\gamma_b$ | 0.7033 | 1.6146 | 1.7664 | 1.7774 | 1.8633 | 1.9065 |
|---|---|---|---|---|---|---|
| 0.2605 | | Y | N | N | N | N |
| 0.2823 | | | N | N | N | N |
| 0.2842 | Y | | N | N | N | N |
| 0.3494 | | | N | | | |
| 0.5117 | | | N | | | |
| 0.5710 | | | N | N | | |
| 0.7033 | Y | | N | N | Y | |
| 0.9878 | | N | N | N | N | N |
| 1.0437 | | | N | N | N | N |

Coincidences observed (Y), not observed (N) between (ce $\gamma_a$)(photon $\gamma_b$) (sl ce)(scin $\gamma$)

Continued

$Bi^{205}$ 83 122 $14.5^d$

Continued

| $\gamma_a$ \ $\gamma_b$ | 0.2822 | 0.2823 | 0.2842 | 0.3494 | 0.5710 | 0.5800 | 0.7303 | 0.9108 | 0.9878 | 1.0437 | 1.7664 | 1.7774 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2605 | Y | | | Y | Y | | Y? | | N | N | N | N |
| 0.2823 | | Y? | N | | | | | | | N | | |
| 0.2842 | Y? | | N | | | Y | N | | | N | N | |
| 0.3494 | N | N | | Y | N | Y | | N | N | | | |
| 0.5117 | | Y | | | | N | | | | | | |
| 0.5710 | | Y | Y | | Y? | N | | | | | | |
| 0.7033 | | | Y | Y | N | | | Y | N | N | | |

Coincidences observed (Y), not observed (N) between (ce $\gamma_a$)(ce $\gamma_b$) (sl ce)(sl ce)

Decay scheme is proposed

56G44 T.R.Gerholm, Arkiv Fysik 11, 55 (1956).

$Bi^{209}$ 83 126

Levels $Bi^{209}(n,n')$ $E_n$ = 4.4 ppl 82°

| σ(mb/sr) | Level |
|---|---|
| 185 *40* | g.s. |
| 20 *10* | (0.895) |
| 135 *45* | 1.9 to 3.5 |

56W36 J.B.Weddell, Phys. Rev. 104, 1069 (1956).

$Bi^{212}$ 83 129 $60.5^m$

$\gamma(Po^{212})$ $1.9^y Th^{228}$ source

35† **1.62** sm Cp

No 1.1γ (<40†), 1.35γ (<20†), 1.5γ (<15†), 1.8γ (<10†), 2.2γ (<5†)

Study covered energy range from 1.0 to 3.5

†Photons per 1000 $3.1^m Tl^{208}$ 2.62 γ's

(6.05 α)(ce 0.040γ) delay = $1.0^{\mu\mu s}$ *5* sl ce

Measured ce momentum as function of $Tl^{208}$ recoil distance (0 to $7.4 \times 10^{-5}$cm)

56B126 J.Burde, S.G.Cohen, Phys. Rev. 104, 1093 (1956).

Po 84

Transylvanian ore chem

α weak ppl

x **Po $L_\alpha$ x ray** S

**Po $L_\beta$ x ray**

Interpreted as evidence for new long-lived Po

56R56 R.Ripan, R.Paladi, H.Hulubei, Proc. Internat. Conf. Peaceful Uses Atomic Energy (Geneva) 7, 392 (1956).

$Po^{196}$ 84 112 $1.9^m$

$\tau$ **1.9$^m$** W(200-Mev $Ne^{20}$) chem

α **6.14**

56A45 H.Atterling, W.Forsling, B.Åström, Physica 22, 1193A (1956).

$Po^{204}$ 84 120 $3.8^h$

$\tau$ **3.5$^h$** *6* Pt(110-Mev $N^{14}$) chem

α **5.35** *5* ic

56B112 W.E.Burcham, B.C.Haywood, Proc. Phys. Soc. 69A, 862 (1956).

$Po^{212}_{84\ 128}$ $0.30^{\mu s}$

Ground state $60.5^{m}Bi^{212}$ source

J $\geq 1$

$(2.25\beta)(8.78\alpha)(\theta)$ $\eta(\pi) = +1.0$ ppl

From analysis of 54 tracks

56B138 A.Beiser, Ann. New York Acad. Sci. 62, 423 (1956).

$At^{203}_{85\ 118}$ $7^{m}$

| | | | |
|---|---|---|---|
| $\tau$ | $7.1^{m}$ 15 | Pt(110-Mev $N^{14}$) | chem |
| $\alpha$ | 6.09 3 | | ic |

56B112 W.E.Burcham, B.C.Haywood, Proc. Phys. Soc. 69A, 862 (1956).

$At^{205}_{85\ 120}$ $26^{m}$

| | | | |
|---|---|---|---|
| $\tau$ | $22.7^{m}$ 40 | Pt(110-Mev $N^{14}$) | chem |
| $\alpha$ | 5.94 3 | | ic |

56B112 W.E.Burcham, B.C.Haywood, Proc. Phys. Soc. 69A, 862 (1956).

$At^{207}_{85\ 122}$ $1.8^{h}$

| | | | |
|---|---|---|---|
| $\tau$ | $1.4^{h}$ 1 | Pt(110-Mev $N^{14}$) | chem |
| $\alpha$ | 5.76 4 | | ic |

56B112 W.E.Burcham, B.C.Haywood, Proc. Phys. Soc. 69A, 862 (1956).

$Rn^{218}_{86\ 132}$ $19^{ms}$

$Th^{226}$ recoils from $U^{230}$

| | | | |
|---|---|---|---|
| $\alpha$ | 0.2%* (6.52)* | | scin $\alpha\gamma$ |
| | 99.8%* 7.127 10 | | s |
| $\gamma(Po^{214})$ | | | |
| | 0.20† 0.609 6 | | scin |

(~6.52 $\alpha$)(0.609 $\gamma$)

*From intensity and energy of 0.609$\gamma$

†Photons per 100 $\alpha$'s

56A38 F.Asaro, I.Perlman, Phys. Rev. 104, 91 (1956).

$Ra^{222}_{88\ 134}$ $38^{s}$

$Ra^{222}$ recoils from $Th^{226}$; $31^{m}Th^{226}$ source

| | | | |
|---|---|---|---|
| $\alpha$ | 4.4%* (6.22)* | | scin $\alpha\gamma$ |
| | 95%* 6.555 10 | | s |
| $\gamma(Rn^{218})$ | | | |
| | 3.6† 0.325 3 | $\alpha_K = 0.08$ | scin x/$\gamma$ |

(~6.22$\alpha$)(0.325$\gamma$)

*From intensity and energy of 0.325$\gamma$

†Photons per 100 $\alpha$'s

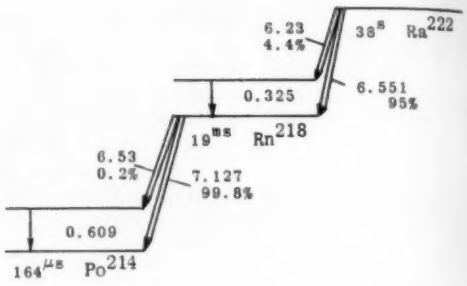
56A38 F.Asaro, I.Perlman, Phys. Rev. 104, 91 (1956).

$21^{d}U^{230}$ source

| | | |
|---|---|---|
| $\gamma(Rn^{218})$ | 0.3246 | sπ ce |

56S88 W.G.Smith, F.Asaro, J.M.Hollander, Phys. Rev. 104, 99 (1956).

$Ra^{222}_{88\ 134}$ $38^{s}$




56A38 F.Asaro, I.Perlman, Phys. Rev. 104, 91 (1956).

$Ra^{223}_{88\ 135}$ $12^{d}$

| | | | | | |
|---|---|---|---|---|---|
| ce | 40* | 0.018 | 45* | 0.067 | ppl |
| | 42* | 0.028 | 16* | 0.076 | (α)(ce) |
| | 58* | 0.043 | 7* | 0.082 | |
| | 99* | 0.054 | 6* | 0.093 | |

(α)(0 ce) in 48% ppl

(α)(1 ce) in 49%

(α)(2 ce) in 2.6%

(α)(0.054 ce)(0.067 ce)

(α)(0.028 ce)(0.054 ce)

*Relative ce intensities

55M97 C.Matiassek, Sitzber Akad. Wiss. Wien Abt. 164, 161 (1955).

$Ra^{226}_{88\ 138}$ $1620^{y}$

| | | |
|---|---|---|
| $\tau$ | $1617^{y}$ 11 | specific activity |

$3.619 \times 10^{10}$ 25 $\alpha$'s/sec g Ra

56S110 W.Sebaoun, Ann. Phys. 1, 680 (1956).

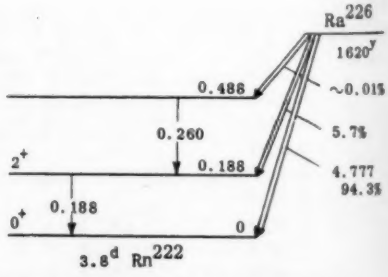
$\gamma(Rn^{222})$ >99.9% pure $Ra^{226}$

| | | |
|---|---|---|
| 100† | (0.188) | scin |
| 0.25† | 0.260 5 | |

(0.260 $\gamma$)(0.188 $\gamma$)

No 0.448$\gamma$ (<0.012†) No 0.663$\gamma$ (<0.01†)

Result indicates that transition to rotational level pattern occurs between Z = 86 and 88




56H71 G.Harbottle, M.McKeown, G.Scharff-Goldhaber, Phys. Rev. 103, 1776 (1956); G.Scharff-Goldhaber, Phys. Rev. 103, 837 (1956).

$Th^{226}$ 90 136 $31^m$

$Th^{226}$ recoils from $U^{230}$

| | | | | | |
|---|---|---|---|---|---|
| α | 0.58% | 6.029 | 19%* | 6.220 | s |
| | 1.7% | 6.095 | 79% | 6.330 *10* | |

| γ($Ra^{222}$) | | | scin |
|---|---|---|---|
| 4.8† | 0.112 *3* | α = 3.0, $\alpha_K \leq 0.4$ | |
| 0.4† | 0.131 *5* | | |
| 0.40† | 0.197 *10* | α ~ 0.4 | |
| 1.2† | 0.242 *3* | | |

(0.112 γ)(~0.130, ~0.190γ, not 0.242γ)

*Contribution of $Ra^{222}$ subtracted

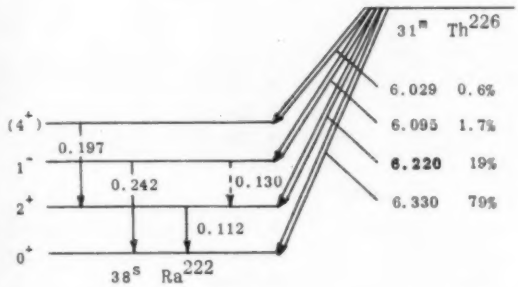
†Photons per 100 α's

56A38 F. Asaro, I. Perlman, Phys. Rev. 104, 91 (1956).

$21^d U^{230}$ source

γ($Ra^{222}$) 0.1111 *3* sπ ce

56S88 W.G. Smith, F. Asaro, J.M. Hollander, Phys. Rev. 104, 99 (1956).




56A38 F. Asaro, I. Perlman, Phys. Rev. 104, 91 (1956).

$Th^{232}$ 90 142

Level $Th^{232}(\alpha,\alpha'\gamma)$ $E_\alpha$ = 3.33; scin

0.050 *5* $\tau = 0.77^{m\mu s}$ *39* (α = 340)

56D40 R.H. Davis, A.S. Divatia, D.A. Lind, R.D. Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

$Pa^{230}$ 91 139 $18^d$

γ($U^{230}$) 0.0517 *1* sπ ce

56H63 Hill, F. Asaro, F.S. Stephens, Jr., J.M. Hollander, quoted by J.M. Hollander, Phys. Rev. 103, 1590 (1956).

$Pa^{233}$ 91 142 $27^d$

τ 27.0$^d$ *1*

56M60 L.D. McIsaac, E.C. Freiling, Nucleonics 14, No. 10, 65 (1956).

$U^{230}$ 92 138 $21^d$

$Th^{232}$(100-Mev p,3nβ) chem

| | | | |
|---|---|---|---|
| α | 0.7% | 5.658 (2 unresolved α's) | s |
| | 32.1% | 5.813 | |
| | 67.2% | 5.884 *5* | |

| γ($Th^{226}$) | | | scin |
|---|---|---|---|
| 0.75† | 0.072 *2* | α = 42 | |
| 0.33† | 0.158 *3* | | |
| 0.24† | 0.232 *3* | | |

†Photons per 100 α's

56A38 F. Asaro, I. Perlman, Phys. Rev. 104, 91 (1956).

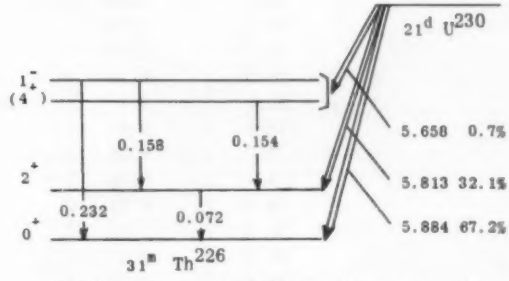
$U^{230}$ 92 138 $21^d$

$Th^{232}$(100-Mev p,3nβ) chem

γ($Th^{226}$) 0.07213 *7* sπ ce

0.1543 *3*

56S88 W.G. Smith, F. Asaro, J.M. Hollander, Phys. Rev. 104, 99 (1956).




56A38 F. Asaro, I. Perlman, Phys. Rev. 104, 91 (1956).

$U^{234}$ 92 142

Resonances $U^{233}(n,f)$ cryst

| $E_o$(ev) | $g\Gamma_n$(mev) | $\Gamma_f$(mev) | $\Gamma_\gamma$(mev) |
|---|---|---|---|
| (−5.0)* | 7.15 | 360 | 41 |
| (0.10)* | 0.00053 | 1000 | 40 |
| 1.785 | 0.20 | 254 | 45 |
| 2.30 | 0.092 | 62 | 40 |
| 3.63 | 0.074 | 157 | 40 |
| (4.5)* | 0.032 | 180 | 40 |
| (4.7)* | 0.022 | 130 | 40 |

*$E_o$ and Γ's needed to fit other resonances

56M74 M.S. Moore, L.G. Miller, C.W. Reich, Bull. Am. Phys. Soc. 1, No. 7, 327 G10 (1956).

$U^{235}$ 92 143 $7.2 \times 10^{8y}$

τ $7.53 \times 10^{8y}$ 22 specific activity

747 ± 22 α's/sec mg $U^{235}$

56K39 G.B. Knight, K-663 (1950); declassified Feb. 1956. Nuclear Sci. Abstr. 10, 7360 (1956).

$U^{235}$ 92 143

Ground state enriched $U^{235}$

q (−?) 3.8 para

56B129 B.B. Bleaney, C.A. Hutchison, P.M. Llewellyn, D.F.D. Pope, Proc. Phys. Soc. 69B, 1167 (1956).

$U^{236}$ 92 144

Resonances $U^{235}(n)$ $E_n$ = 1.5 to 60ev fast chopper

| Γ(mev) | $E_o$(ev) | $\Gamma_n^0$(mev) | $\Gamma_f$(mev) |
|---|---|---|---|
| 138 *5* | 0.290 *5* | 0.0037 *1* | 98* *7* |
| 142 *7* | 1.13 *1* | 0.0146 *6* | 107* *10* |
| 43 *5* | 2.04 *3* | 0.0066 *3* | 12* *3* |
| | 2.82 *5* | 0.0026 *7* | |
| 150 *40* | 3.14 *2* | 0.028 *2* | 115 *44* |
| 80 *20* | 3.61 *2* | 0.053 *3* | 45 *24* |
| 46 *20* | 4.84 *2* | 0.054 *5* | 4* *2.5* |
| | 5.45 *10* | 0.022 *4* | |
| | 5.83 *10* | 0.016 *3* | |
| | 6.12 *10* | 0.027 *4* | |
| 53 *10* | 6.40 *5* | 0.30 *3* | 18 *14* |

Continued

**$U^{236}$** 92 144

Continued

| $\Gamma$(mev) | $E_o$(ev) | $\Gamma_n$[$](mev) | $\Gamma_f$(mev) |
|---|---|---|---|
| 56 *15* | **7.10** *5* | 0.11 *2* | 21 *19* |
| 95 *15* | **8.82** *7* | 1.3 *1* | 59 *19* |
| | **9.3** *1* | 0.11 *2* | |
| | **9.8** *1* | 0.025 *4* | |
| | **10.2** *1* | 0.065 *8* | |
| | **10.6** *1* | 0.033 *7* | |
| | **11.1** *1* | 0.045 *7* | |
| 42 *15* | **11.7** *1* | 0.79 *8* | 6 *19* |
| 61 *15* | **12.4** *1* | 1.4 *1* | 25 *19* |
| | **13.4** *1* | 0.08 *2* | |
| | **13.8** *1* | 0.15 *3* | |
| | **14.1** *1* | 0.20 *3* | |
| | **14.6** *2* | 0.17 *2* | |
| | **15.5** *2* | 0.27 *3* | |
| | **16.1** *2* | 0.29 *4* | |
| | **16.8** *2* | 0.29 *4* | |
| | **18.1** *2* | 0.46 *7* | |
| | **18.7** *2* | 0.20 *6* | |
| 120 *20* | **19.3** *2* | 3.2 *3* | 82 *24* |
| | **20.6** *2* | 0.36 *11* | |
| | **21.1** *2* | 0.9 *3* | |
| | **22.1** *3* | 0.09 *2* | |
| | **22.9** *3* | 0.65 *8* | |
| | **23.5** *3* | 1.8 *2* | |

| $E_o$(ev) | $\Gamma_n$[$](mev) | $E_o$(ev) | $\Gamma_n$[$](mev) |
|---|---|---|---|
| **24.4** *3* | 0.44 *6* | **30.7** *4* | 0.44 *7* |
| **25.3** *3* | 0.38 *7* | **31.1** *4* | 0.45 *8* |
| **25.8** *3* | 0.31 *6* | **32.1** *4* | 1.2 *2* |
| **26.5** *3* | 0.49 *9* | **33.6** *4* | 2.2 *4* |
| **27.3** *3* | 0.11 *4* | **34.6** *5* | 4.5 *9* |
| **27.9** *3* | 0.78 *11* | **35.3** *5* | 7.7 *15* |

[$]Used $\Gamma = 100 \pm 20$ mev when $\Gamma$ was not determined
[*]Used "world's best" $\sigma_f$ curve; remaining $\Gamma_f$'s obtained using $\Gamma_\gamma = 35 \pm 4$ mev

**56P33** V.E.Pilcher, J.A.Harvey, D.J.Hughes, Phys. Rev. 103, 1342 (1956).

Resonances $U^{(235)}(n,f)$ pulsed n's

| $E_o$(ev) | $\sigma_f\Gamma$(ev-b) |
|---|---|
| **8.8** | 113 *10* |
| **11.7** | 11.8 *3* |
| **12.3** | 50 *5* |
| **19.3** | 111 *10* |

**56Y03** M.L.Yeater, W.R.Mills, E.R.Gaerttner, Phys. Rev. 104, 479 (1956).

**$U^{238}$** 92 146

Level $U^{(238)}(\alpha,\alpha'\gamma)$ $E_\alpha = 3.33$; scin

**0.045** *3* $\tau = 0.44^{m\mu s}$ *22* ($\alpha$ = 700)

**56D40** R.H.Davis, A.S.Divatia, D.A.Lind, R.D.Moffat, Phys. Rev. 103, 1801 (1956); 100, 1266A (1955).

**$U^{239}$**? 92 147

Reaction $\gamma$'s $U^{238}$(pile n,?)

| $\sigma$ | $E_\gamma$ | |
|---|---|---|
| 1.3 *3* | **4.0** *1* | scin pr |
| 0.20 *7* | **5.9** *1* | |
| 0.10 | **7.5** *2* | |

**56K34** R.W.Kenney, J.T.Mattingly, Bull. Am. Phys. Soc. 1, No. 8, 389 M4 (1956).

**$Np^{236}$** 93 143 $22^h$

| | | |
|---|---|---|
| $\gamma(U^{236})$ | **0.04528** *6* | scin ce |
| $\gamma(Pu^{236})$ | **0.04463** *10* | |

**56A40** R.G.Albridge, J.M.Hollander, quoted by J.M.Hollander, Phys. Rev. 103, 1590 (1956).

**$Np^{237}$** 93 144 $2.2 \times 10^{6y}$

| | | |
|---|---|---|
| $\gamma(Pa^{233})$ | **0.030** | scin $\alpha\gamma$ |
| | **0.087** | |
| | **0.140** | |
| | **0.200** | |

$\alpha$(0.030, 0.087$\gamma$) delay = $37^{m\mu s}$
$\alpha$(0.140, 0.200$\gamma$) delay < $2^{m\mu s}$

**55S88** D.Strominger, J.O.Rasmussen, Phys. Rev. 100, 844 (1955).

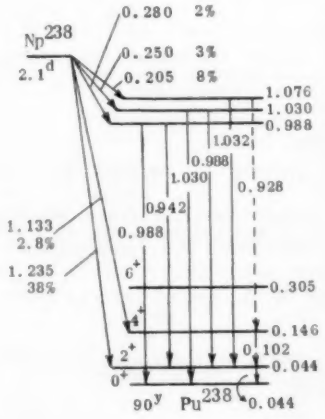
**$Np^{238}$** 93 145 $2.1^d$

| | | |
|---|---|---|
| $\beta^-$ | 8% ~**0.200**? | Np(pile n,$\gamma$) chem; sd |
| | 31% **0.250** *10* | |
| | 20% **0.280** *10* | |
| | 2.8%* (**1.133**) | |
| | 38% **1.236** *5* | |

$\gamma(Pu^{238})$

| | $\alpha$ | $L_2$: $L_3$: $M_2$: $M_3$ | |
|---|---|---|---|
| **0.044** | large | 250: 228: 125: 62 | [sd ce |
| **0.102** | large | 131: 69: 43: 38 | [scin |
| **0.942** | | | |
| **0.988** | $K/L_2 = 3.2$ | | [sd ce |
| **1.030** | | | [scin |
| **1.032** | | | |

[*]From (>0.50$\beta$)(ce 0.044, 0.102$\gamma$) scin




**56B95** S.A.Baranov, K.N.Shlyagin, J.Nuclear Energy 3, 132 (1956); Soviet J. Atomic Energy No. 1, 51 (1956).

**$Np^{239}$** 93 146 $2.3^d$

| | | | |
|---|---|---|---|
| $\gamma(Pu^{239})$ | **0.2092** | $\alpha_K = 1.76$ *15* | cryst, |
| | **0.2282** | $\alpha_K = 1.60$ *8* | sl ce |
| | **0.2778** | $\alpha_K = 1.16$ *6* | |

**56E13** G.T.Ewan, J.W.Knowles, D.R.Mackenzie, Bull. Am. Phys. Soc. 1, No. 7 330 J8 (1956); verbal report.

**$Np^{239}$** 93 146 $2.3^d$

$U^{238}(n,\gamma\beta)$ chem

| | | | | | | |
|---|---|---|---|---|---|---|
| $\beta$ | 22% | 0.070? 5 | 16% | 0.439 5 | | sd |
| | 35% | 0.327 5 | ~2% | 0.655? | | |
| | 21% | 0.382 5 | 4% | 0.723 5 | | |
| $\gamma(Pu^{239})$ | | 0.012? | | | | sd ce |
| | w | 0.0444 | $L_1/L_2 = L_1/L_3 \sim 1.5$ | | M1 + E2 | |
| | w | 0.0493 | $L_2/L_3 \sim 1.0$ | | E2/M1 = 4 | |
| | w | 0.0572 | $L_2/L_3 \sim 1.0$ | | E2 | |
| | w | 0.0614 | | | E1? | |
| | st | 0.0679 | $L_2/L_3 \sim 1.0$ | | E2 | |
| | st | 0.1062 | | | E1? | |
| | st | 0.2103 | K/L ~6 | | M1 | |
| | st | 0.2284 | K/L ~4.8 | | M1 | |
| | | 0.2781 | K/L ~4.7 | | M1 | |
| | | 0.334 | | | M1 | |

(0.106$\gamma$)(>0.200 $\gamma$'s) scin

Decay scheme proposed

56B95 S.A.Baranov, K.N.Shlyagin, J. Nuclear Energy 3, 132 (1956); Soviet J. Atomic Energy No. 1, 51 (1956).

**$Pu^{238}$** 94 144 $90^y$

$\gamma(U^{234})$ **0.04350** 4 sm ce

56S92 W.G.Smith, J.M.Hollander, quoted by J.M.Hollander, Phys. Rev. 103, 1590 (1956).

$\gamma(U^{234})$ d $Cm^{242}$ chem

| | | | |
|---|---|---|---|
| 38 4† | 0.04349 8 | | pc in |
| 10 2† | 0.0998 4 | | magnetic |
| 1.1 2† | 0.1531 6 | | field |
| x | L x ray | | |

No K x ray (<1.2†)

†Photons per $10^5\alpha$'s. Compared 0.043$\gamma$ intensity and $\alpha$-decay rate to those of $Am^{241}$ using $0.060\gamma/\alpha = 0.40 \pm 0.025$.

56N17 J.O.Newton, B.Rose, J.Milsted, Phil. Mag. 1, 981 (1956).

**$Pu^{241}$** 94 147

Resonance $Pu^{240}$(n, f) cryst

(1.06 ev) $\sigma_0 = 30$

56L19 B.R.Leonard,Jr., E.J.Seppi, W.J. Friesen, E.M.Kinderman, Bull. Am. Phys. Soc. 1, No. 5, 248 C13 (1956).

**$Am^{242}$** 95 147 $16^h$

| | | |
|---|---|---|
| $\gamma(Pu^{242})$ | 0.04450 6 | sm ce |
| $\gamma(Cm^{242})$ | 0.04212 6 | |

56A41 R.G.Albridge, B.G.Harvey, J.M. Hollander, quoted by J.M.Hollander, Phys. Rev. 103, 1590 (1956).

**$Am^{246}$** 95 151 $25^m$

$11^d Pu^{246}$ source

| | | | |
|---|---|---|---|
| $\beta^-$ | ~1.1 | | scin $\beta\gamma$ |
| | 79† 1.31 | | s, scin |
| | 14† 1.60 | | scin |
| | ~7† 2.10 | | |
| $\gamma(Cm^{246})$ | ~0.035 | w 0.245 | scin |
| | 0.100? | ~0.78 | (complex) |
| | 0.175 to 0.180? | ~1.06 | (complex) |

Continued

**$Am^{246}$** 95 151 $25^m$

Continued

$E_{dis} = 2.41$ *10* from (1.6$\beta$)(~0.8$\gamma$); (1.31$\beta$)(~1.1$\gamma$) $\gamma\gamma$ and $\beta\gamma$ studied; results listed in their tables 2 and 3

56S85 H.L.Smith, C.I.Browne, D.C.Hoffman, J.P.Mize, M.E.Bunker, J. Inorg. Nuclear Chem. 3, 93 (1956).

**$Cm^{242}$** 96 146 $162^d$

| | | |
|---|---|---|
| $\gamma(Pu^{238})$ | 0.0441 | sd ce |
| | $L_2:L_3:M_2:M_3:N_2 = 495:420:325:170:80$ | |

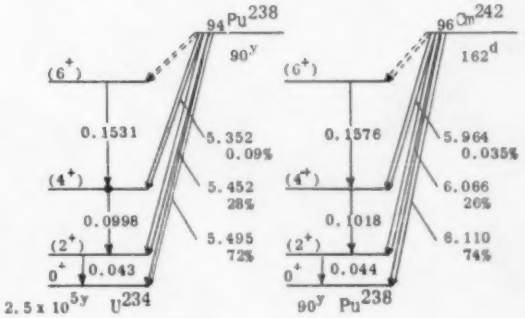
56B95 S.A.Baranov, K.N.Shlyagin, J. Nuclear Energy 3, 132 (1956); Soviet J. Atomic Energy No. 1, 51 (1956)

$\gamma(Pu^{238})$ $Am^{241}$(n,$\gamma\beta$) chem

| | | | |
|---|---|---|---|
| 390 70† | 0.04403 6 | | pc in |
| 35 8† | 0.10180 17 | | magnetic |
| 23 5† | 0.1576 3 | | field |
| x | L x ray | | |

†Photons per $10^6\alpha$'s. Compared 0.044$\gamma$ intensity and $\alpha$-decay rate to those of $Am^{241}$ using $0.060\gamma/\alpha = 0.40 \pm 0.025$.

56N17 J.O.Newton, B.Rose, J.Milsted, Phil. Mag. 1, 981 (1956).




56N17 J.O.Newton, B.Rose, J.Milsted, Phil. Mag. 1, 981 (1956); F.Asaro, I.Perlman, Phys. Rev. 94, 381 (1954).

**$Cm^{243}$** 96 147 $35^y$

$\tau$ **35.0$^y$** specific activity

56T29 S.G.Thompson, U.S. patent 2,741,627; Chem. Abstr. 50, 11849a (1956); priv. comm.

$\gamma(Pu^{239})$ $Am^{241}$(2n,$\gamma\beta$) chem

| | | | |
|---|---|---|---|
| 50 15† | 0.210 2 | | pc in |
| 65 15† | 0.228 2 | | magnetic |
| 100 † | 0.277 2 | | field |
| x 360 40† | 0.1022 2 | ($K_\alpha$ x ray) | |
| 140 20† | 0.1173 4 | ($K_\beta$ x ray) | |

56N17 J.O.Newton, B.Rose, J.Milsted, Phil. Mag. 1, 981 (1956).

**$Cf^{250}$** 98 152 $9.3^y$

$\tau$ **9.3$^y$**

56B100 J.P.Butler, T.A.Eastwood, T.L. Collins, F.M.Rourke, R.P.Schuman, quoted by Butler et al. Phys. Rev. 103, 965 (1956).

$^{250}_{98}Cf_{152}$ $\gamma(Cm^{246})$ **0.0429** *1* 57 ce

$9.3^{y}$

56H64 B.G.Harvey, J.M.Hollander, quoted by J.M.Hollander, Phys. Rev. 103, 1590 (1956)

$^{252}_{98}Cf_{154}$ $\gamma(Cm^{248})$ **0.0434** *1* 57 ce

$2.2^{y}$

56H64 B.G.Harvey, J.M.Hollander, quoted by J.M.Hollander, Phys. Rev. 103, 1590 (1956).